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School Science and Mathematics

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GLEN W. WARNER
Editor
7633 Calumet Ave., Chicago

W. F. ROECKER
Business Manager
3319 N. 14th St., Milwaukee

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SCHOOL SCIENCE
AND
MATHEMATICS

VOL. XLII JUNE, 1942 WHOLE NO. 368

WILL THE NATIONAL EMERGENCY TEACH US ANYTHING IN CURRICULUM BUILDING?

G. H. JAMISON
Problem Department Editor

In the March 1942 issue of SCHOOL SCIENCE AND MATHEMATICS the editor, Dr. Warner, raises the question, "What can the schools do for America?" From many quarters a very serious charge is being brought against the type of public education which has prevailed for the last few decades. In fact those who now have charge of solving America's greatest problem, indeed, our one great problem, namely, the winning of the war, are greatly hampered because our young men are not prepared in certain fundamentals. The criticism voiced at our school program is so serious that all of us should become aroused. When the navy department addresses a letter to everybody having anything to do with our educational planning and urges that our curriculum meddling stop and that we get back to those studies which are so sorely needed in the war effort, it is time that we pay heed to our defects.

Suppose we examine some of the failures so keenly observed by those directing our war effort.

We might as well admit that not only have our so called educational leaders been short sighted but we also in mathematics have failed to have the vision of long time needs. We have always urged as one justification for mathematics that it has cultural values. Also, that it emphasizes a type of thinking which is always needed. We have not been sufficiently outspoken in its very great aid as a tool subject. Many young men in the past few years who have had no desire to study mathematics

now are returning to our class rooms in order to prepare themselves to do certain things. It does seem that a subject so basic to the material development of civilization, so interwoven with almost every advance society takes, so necessary when nations face their hour of peril, and also so valuable in its contribution to the personal development, of people, should to say the least, be part of the educational program of every pupil in our public schools.

We have seen mathematics along with most other academic subjects of the high school very poorly taught. Young people have not learned the subject matter of mathematics. They have not developed the ability to do mathematical thinking. They have not learned how to explore a problem, how to attack it, how to get all facts, pictures, diagrams, related material. They have not acquired habits of neatness, accuracy. Nor has the attitude of seeing the task through to the complete solution been inculcated. We must admit that mathematics as it has been taught, as we see the results in the lives of youth, is very, very bad. No subject has been the target of criticism as has mathematics. For one reason, the results of its instructions are more easily seen. This adverse criticism has been justified. It should however, be emphasized that much of the criticism should have been toward improvement rather than toward a throwing-out of the subject. Children have approached mathematics with a keen dislike even before it has been studied. An almost universal destructive attack on mathematics has resulted in a poorer type of mathematics. Standards for teachers have been lowered. Pupils have been made to feel that the subject had no valid contribution to their lives. Hence, they approached it in a half hearted manner. The subject matter has often been deleted of much good material. We have sifted until only the "minimum essentials" are left. If we were to adopt the same attitude in horticulture we would discard all attempts to grow apples when our orchards, allowed to grow without care and cultivation, produced nothing worth while. We would say, "Well since the apples are no good, we will quit the effort to produce fruit." Rather we seek the causes of failure. We cultivate, prune, spray, improve. So should we in mathematics. We need to teach for the attitudes, habits of thinking, ways of approach to problem solving, and results needed later on. We can't expect poor teaching to produce anything but poor results.

Another failure of our education is that discipline as a factor

in the personality of young people has almost disappeared. We have developed an easy going attitude almost toward everything We "hitch hike" through many phases of the school program. People should be taught early to carry their own load.

In our school program, too often, we have suggested to children that they should determine the program to follow. If a task is difficult, avoid it. Find an easier way. This however, is not the way of life. We must do the hard tasks. In fact life for most of us is hard. The immediate present has dictated our program and not the long time needs of society. In the effort to make play of school work, mathematics did not fit well into the scheme. Also by great, so-called diligent research efforts, it was found that scarcely any one used mathematics, hence, six weeks spent on arithmetic should be sufficient. Another result was that algebra and geometry might as well be put in the archives of history. It is interesting to observe that the football coach does not employ such sugar coated pedagogical ideas. He knows that the boy must go through hard training before the day of the game. He will not tolerate the slip-shod methods that have pervaded the academic areas. If the coach does not insist on the discipline which makes a boy get in condition whether he likes it or not, to that extent he is a failure. It is true that most every coach today will tell you that it requires greater effort to instill discipline than in past years.

As a result of the almost complete failure of our schools to teach any semblance of discipline, those in charge of our war effort are finding one of their hardest tasks. We need everywhere in school to teach young people to take charge of themselves, to the end that they will not fear to undertake a hard task just because it is hard. Mathematics is one of the best subjects in high school, because of its exactness, because of the type of thinking required, to teach this important by product so sorely needed now, namely, personal self-discipline.

Another excuse for the absence of mathematics in the high school curriculum is that so many boys and girls can not learn mathematics. It may be true that they do not learn it. It is also true that they do not learn their English, their history, and the other academic subjects. The fault is not with the boys and girls but with the teaching. Most boys and girls will meet, under proper teaching, what ever challenge is placed before them. We have with mass education many people who do not care to learn. This is no reason for our failure to offer to those who can

and should learn, a chance to develop and to make a start in those fields of their particular aptitudes. We must always have leaders. It is too bad that to-day in our colleges there are not thousands of boys who have gone through calculus. Many have had no mathematics beyond a unit of algebra or so called general mathematics. We now suffer from the sugar-coated "minimum essential," do as you please, educational theory.

Will we learn anything from the present tragic situation? It is very doubtful that any progress in public education will be made as long as education is dominated by one particular group of people. Education in so serious a matter that our greatest minds should be devoted to it. Let the strategy board include the educational theorist, but also it should have the benefit of the real scholar and thinker from such fields as English, the classics, science, mathematics, history, sociology. The real thinkers are not the faddists. They will see through the shams and appreciate the long time needs of society. Our present day crisis has not been solved nor will it be solved apart from those who have grounded their educational life in some academic field. We must free education from the "racket" which is so similar to great political machines of our cities. Our society to-day is unprepared in the fundamental sciences, mathematics, and English to meet our National Emergency. Let us hope that we can face about and no longer let the side shows or the fads be the main show. Let us go back to the fundamental abiding subjects of study but with a new philosophy of teaching.

Another pertinent observation is this. If mathematics as a high school subject, comes back into the curriculum, we dare not present the same type of mathematics which has been characteristic of our teaching for years. Our teachers have been poorly prepared. In fact, it has seemed that most anybody might be selected to teach mathematics provided he had a vacant hour at the right time. The subject has been treated mostly as a set of rules to be followed. It has been deadening, with no great motivating urge back of it. It has been mechanical with no understanding of its processes. It has failed to produce any transfer, largely because there was nothing taught which could transfer. It has not been real mathematics which first of all implies understanding and thinking. Hence, we must teach a mathematics which is worthy to be studied. It must be interesting. Young people can be interested in mathematics if it be presented in an interesting way. It must be useful. It must be

seen as a necessary part of the development of civilization. It is a tool subject as is revealed in the National Emergency. We must have mathematics, not only for war, but also for peace. But mathematics is far more than a tool subject. It should make its contribution in the lives of people.

All this implies a very serious attitude toward the teaching problem. Our present plight is one of our own making. The fault is not with children. We have, by our teaching brought the structure down upon ourselves. We must have teachers with far greater preparation. They should know far more mathematics than they now know. They should know its meaning to civilization. They should know related fields such as physics. They should believe in the subject they teach.

Hence, it will be folly even to urge a return of mathematics, unless, we, the teachers of the subject, are prepared to teach a better, more significant mathematics.

1942 COLLEGE CHEMISTRY TESTING PROGRAM

The College Chemistry Testing Program is conducted annually under the sponsorship of the Division of Chemical Education of the American Chemical Society. The examinations are provided through the joint efforts of the Committee on Examinations and Tests of the Division of Chemical Education and the Cooperative Test Service of the American Council on Education.

Three tests are available for use in college courses in chemistry this year:

(1) *The Cooperative General Chemistry Test for College Students, Form 1942.* This is a 110-minute test with four parts covering General Knowledge and Information, Application of Principles, Scientific Method, and Laboratory Technique. The section on laboratory technique is optional; the test may be given with or without it. The test is intended for students completing a first-year course in college chemistry.

(2) *The Cooperative Organic Chemistry Test, Form S.* This 100-minute examination is intended for use with students completing a one-year course in organic chemistry. The test was developed from a series of topical tests in organic chemistry compiled by Dr. E. F. Degering, Purdue University, with the assistance of a large number of teachers of organic chemistry.

(3) *The Cooperative Chemistry Test in Qualitative Analysis, Provisional Form Q.* This 60-minute examination is based on an analysis of the objectives of one-semester courses in qualitative analysis. Topics covered are (a) Applications of the laws of solution; (b) Equations of typical analytical reactions; (c) Numerical problems dealing with solubility product, ionization constant, pH and common-ion effect.

The examinations used in the 1942 College Chemistry Testing Program should be administered during May or June, as near the end of the school year as possible. Results should be returned to the Cooperative Test Service, 15 Amsterdam Ave., New York, by June 20 in order that national norms may be compiled and reports sent to colleges during the summer.

WATCHING SUMMER BIRDS

LAURA B. YOUNG
3115 North Capitol Avenue, Indianapolis, Indiana

EDITOR'S NOTE. This article is the third and last of a series of articles by Laura B. Young, naturalist and writer of children's stories and verse. The first article, "Watching Winter Birds," appeared in the January issue of SCHOOL SCIENCE AND MATHEMATICS. The second article, "Watching Spring Birds," appeared in the March issue. These three articles together with their verse and illustrations, make interesting material for teachers to use in developing activities for bird-study in the elementary grades.

With spring migration over, mates selected, building sites located, and nest building on the way, the birds have accomplished a great deal. Some early arrivals raise three and sometimes four broods during the season.

The true nesting time for all birds, even in warm or tropical climates, begins in the spring when the rainy season comes and food is plentiful.

Birds are at their best physically, and I would think mentally, in spring and early summer. At this time their plumage is the most beautiful, both as to color and general condition. It is a time of great happiness, and their songs are heard throughout the day and evening.

The Mimic

The robin's song, the thrush's call,
Then a mewing noise I heard,
And looking at me from the mulberry tree
Was a beautiful, gray cat bird.

Birds use great care in selecting a building site. Protection and food supply must be considered.

Old unsprayed orchards are usually a haven for bird life, especially if the trees are large and have not been trimmed. Hollow places in the dead wood furnish houses for woodpeckers, bluebirds, chickadees, and owls. Abundant insect life in the orchard assures the birds their food supply.

The Bluebirds

You have a nest in the hole
  Of the old sweet-apple tree.
You go in and out, out and in
  As busy as you can be.

You leave in such a hurry
  And in a minute you return
With your mouth crammed full of insects
  Or a very fat large worm.

I think that you have young
And I'm sure it must be true.
For I see your mate is helping
With worms and insects, too.

The importance of bird life can not be overestimated, as hundreds of insects in various stages are eaten by a bird in a few hours. Authorities claim that without birds the earth would soon become uninhabitable because of the rapid increase of insects.

WORM-EATING WARBLER

Grain eating birds eat the seeds of weeds and are very helpful in keeping the weed crop under control.

All perching birds, our familiar woods and backyard birds, must make a nest suitable for incubation and also suitable to serve as a home for the young until they are able to take care of themselves. Therefore the nest must be fairly substantial.

A Brown Thrasher's Nest

In a bush of purple Lilacs,
The flowers I love best,
Hidden away among the leaves
Is a brown thrasher's nest.

One reason birds' nests vary so much in construction and material is because of the great difference in the beaks and feet of birds. These are their tools, and the "tailors," "weavers," and

"masons," having different kinds of tools, build different kinds of nests.

How fortunate it is for us that all birds do not nest close to streams, where the water supply would be assured. Instead, many come into our yards and nest in trees and bushes, trusting us to do our part for their comfort and existence.

After the young have hatched, the parent birds have an almost endless task of carrying food. Mouths of young birds are very large in proportion to the rest of body, and their beaks are open most of the time as they cry for food.

Young birds grow very rapidly, and when old enough to try their wings the parent birds give them encouragement and help. The parents will fly to a twig close by, calling and coaxing the little ones, who seem to want to leave the nest but hesitate to do so.

Parent birds protect their young,
To keep them free from harm,
And when an enemy approaches
They give a cry of alarm.

Birds seem to know each other
As plainly as can be.
The signal is sounded from bird to bird,
And carried from tree to tree.

So each little, dear little family,
For a guard has a parent bird.
Who knows when danger is lurking near
By the cry of alarm he heard.

Most young birds are very awkward, as the tail feathers have not grown enough to help balance them.

One after the other, the young birds finally leave the nest, hopping clumsily from branch to twig. If the young hop to the ground, the parent birds become excited, calling to them to come back. They know when they are in danger.

When a bird starts to fly it raises its wings and presses down. As it lifts its wings it bends them at the joint, then the bird straightens its wings and presses down again. In this manner the bird pushes against the air and is lifted upward.

Parent birds feed the young long after they have deserted the home nest, and are as large as their mother and father.

A bird's feathers are arranged in such a way that the small feathers are close to its body for protection. Under these, next to the bird's skin, is a layer of fine down. The long wing feathers

are used in flying, and the tail feathers act as rudders and help balance the bird.

Before and during the moult birds look untidy, as the feathers have become worn and broken during the nesting season. This is especially true of birds that live in holes in trees. Some birds moult twice a year, but autumn is the real moulting season.

THE ROBIN'S NEST

Some birds shed only the tips of the feathers in spring, and in this way the bright underneath feathers show, giving the bird a different appearance. This is true of some of the finches.

Often by quiet observation we see unusual and unexpected things in Nature.

I once had the wonderful experience of holding a wood thrush in my hand. I picked it up from the driveway. It was springtime, and of course the bird was fully grown. It was not injured

in any way, and gave every appearance of being a healthy, normal bird. It made no effort to get away, and did not seem the least bit frightened. Perching on my hand it looked about and trilled a few notes. I then put it in the syringa bush and it flew away. I shall always remember the thrill of holding that small, warm, wild bird. The bird might have been very tired because of a long flight, but I feel that perhaps it had never been frightened and had never known danger, thus it was fearless.

One spring a marsh wren came into my room through the open window. It perched on the foot of the bed, trilling a little song. It flew downstairs onto the breakfast room light, swinging and chirping. When I opened the door it flew outside. I wished that I might have such an interesting caller every morning.

I once had a pair of house wrens that built their nest in a paper bag which was partly filled with onion sets. The bag hung on a nail inside the garage, and had a small opening in the top, just large enough for the wren to slip inside. In this bag the wrens reared their brood. Birds often build their nests in peculiar places. They are often found over doors, on window sills, under eaves, and in the crevices and corners of old buildings.

A pair of mourning doves built their nest under the garage eaves. The nest was completed and one egg was laid, when for some reason the birds deserted it. Soon a pair of robins started building on top of the doves' nest, building in the usual way but using the doves' nest as a foundation for their own. The garage doors sliding back and forth did not bother them in the least.

During a hot, dry spell in summer, spray from the hose is a real treat for birds. One will come, then another and another, until a dozen or more are hopping about in the water and digging in the soft, moist ground for worms that have come close to the surface because of the moisture. The birds will come very close to the person sprinkling if no movement is made to frighten them.

Becoming acquainted with different kinds of birds, and learning their habits by observation, make bird study very interesting.

EDUCATOR AT EIGHTY

"Do you contemplate, even remotely, resigning?" a *New York Times* reporter asked Dr. Nicholas Murray Butler on his eightieth birthday. Replied the President of Columbia: "Not until I die—the reason being if I did resign I would die right off. The forty hour week has no charm for me. I'm looking for a forty hour day. My work isn't finished."

SCIENCE, MATHEMATICS AND THE WAR

HOMER W. LESOURD
Physics Editor, Milton Academy, Milton, Mass.

"Two basic principles have emerged during the past year: first, education earnestly and sincerely desires to serve the national defense to the fullest extent; and second, the agencies of national defense, including the military, are with equal earnestness and with equal sincerity seeking to develop their programs with the least possible disturbance of basic economic, social and cultural institutions." This statement by Dr. Francis J. Brown of New York University although written in 1940 should still be the guiding principle in streamlining our school courses in science and mathematics to meet the urgent needs of our government for students who are mentally alert and adequately trained in the fundamentals of science and mathematics.

"This is a new day even in the ways of war. As in no other struggle in the history of the world, this conflict is between the scientific and technological resources of nations. Tanks, airplanes, ships, bombs—these and similar applications of the inventive genius of man, implemented through test tubes in laboratories and through hordes of mechanics in vast factories—these are the instruments of modern warfare."[1] School administrators are well aware of these demands and many of them will respond by giving priority rating to science and mathematics in this emergency. Upon teachers in these fields there rests the special responsibility to meet this challenge. Conventional courses may have to be altered somewhat in content and in emphasis. New courses—aviation, meteorology, radio, etc.—may advantageously be provided. Teachers may be forced to master subjects which are new for them in order to prepare themselves to conduct these special courses.

Several conferences on special war courses for schools have been held recently in the Eastern section of the country.[2] On these occasions educators and military advisors have exchanged ideas and have offered suggestions as to how schools can best cooperate with governmental agencies by introducing certain fundamental training without serious disruption to the basic curriculum.

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[1] *All-Out Defense Job Training*, 1941.

[2] Teachers College, New York City, Harvard Graduate School of Education, Pawling School, St. Marks School.

Dr. Ben Wood, well-known through his official connection with the Educational Records Bureau, has been appointed chairman of the national advisory committee on aviation education. To school executives and teachers he brings word of the desperate need for a reservoir of "air-conditioned" students of high-school age, from which can be drawn not only airplane pilots but also navigators, gunners, ground-crew men and workers in our airplane factories. Without disparagement of other fields of science, it seems obvious that physics is the particular subject most needed for this purpose. There is at the present time a concerted move among school administrators in some of the eastern states to promote more interest in physics and mathematics. In some schools courses based on physical principles will be given under the name of Aviation or Aeronautics. Such courses will probably appeal to more students than they would if labeled "Physics." Teachers are aware that when the learner sees a definite objective, learning is rapid. When he has a vague objective, learning is slow. The present national emergency should prove to be a powerful incentive to all serious-minded students, even to those who can claim no special mechanical skill or aptitude. Instructors in the Civilian Pilot Training organization assure us that most of the material embodied in the pre-flight ground school courses is within the grasp of students 16 to 18 years of age.

The Secondary Education Board is an organization which includes about 200 independent schools, sometimes designated as "private schools." A recent bulletin tabulates the war-time courses and special activities of various schools of this group. The list includes,—"Applied Mathematics," Aviation, Internal Combustion Engines, Radio, Navigation, Military Maps, Blue Print Reading, Shop Work, Meteorology, Photography, and in a somewhat different category, Military Drill, Rifle Practice, First Aid, Civilian Defense and Community War Efforts.

In some schools these courses have equal standing with commonly accepted curriculum subjects; sometimes they are offered as elective minors with less class periods per week than other subjects; sometimes they function as special clubs.

The problem of securing competent instructors for these "war courses" is obviously a serious one. Very little assistance can be expected from those best qualified to teach these subjects, for their services are at present at the command of the government. If such courses are to be offered it seems inevitable that,

in most schools the teachers of science and mathematics will be expected to assume responsibility for organizing and conducting the classes. Many of these teachers will feel ill-prepared for the task but this can be remedied if there is the will to work. Already there are many teachers enrolled in special "defense courses" offered by colleges and technical schools, while others are doing intensive studying with the aid of text books and special instructional material which the government and other agencies provide.

The reward for the teacher will come in the knowledge that he is making a valuable contribution to America's war effort. Furthermore he will discover that the subjects have much inherent interest both for the teacher and the student.

MATHEMATICS TEACHERS WILL MEET AT DENVER

The National Council of Teachers of Mathematics will hold its next annual summer meeting jointly with the Department of Secondary Education of the National Education Association on June 29 and 30, 1942 at Denver, Colorado.

The following are a few of the topics that will be discussed at the sectional meetings:

"Soap Films," Dr. Charles A. Hutchinson, University of Colorado.

"Do Our Elementary Arithmetic Programs Show Real Concern for Pupil Maturity and Need?" Mrs. Zella K. Flores, Elementary Supervisor at Lewistown, Montana.

"Mathematics and Youth," Mr. Lon Edwards, Colorado State College of Education at Greeley.

"Mathematics as a Useful Language," Mr. J. C. Stearns, Ryerson Laboratory, The University of Chicago.

"Tailoring Mathematics to Fit the Community," Miss Mary A. Potter, Supervisor of Mathematics, Racine, Wisconsin.

"The Double Track Program in High School Mathematics," Dean Harl Douglas, University of Colorado.

FORD ON SCHOOLS

"Even during the war we cannot afford to neglect the youngsters. Some people think that because we're in war, the things our children need in the way of education, and all that should go with it, are luxuries we cannot now afford. They claim taxes will be too high. About the only good use I can see for money is to do something worthwhile with it that will help the children. Decidedly, we can't cut down now on the money we spend to make sturdy, healthy, and intelligent citizens of them."—*Nation's Schools*, April 1942.

"God give me strength to face a fact though it slay me."—HUXLEY.

LOCATING THE 1940 CENTER OF POPULATION

W. A. COGSHALL

Director of the Department of Astronomy
Indiana University, Bloomington

EDITOR'S NOTE. Beginning with the first census in 1790, the center of population has always been at some point near the 39° parallel of latitude. In 1890 the center of population moved from Kentucky into Indiana and has gradually advanced across the state each ten years. Since 1900 Professor Cogshall has used the data from each ten-year report from the Bureau of the Census and, with his astronomical equipment, has located the exact center of population. The center of population for 1940 was located at 38° 56′ 54″ north latitude and 87° 22′ 35″ west longitude. In this article Professor Cogshall explains how he found the location of this point.

There are several ways of finding the latitude and longitude of a point on the earth, some giving greater precision than others and requiring long and expensive programs, others less accurate but done in short time with portable instruments.

In finding the point on the earth having the latitude and longitude given by the Census Bureau, great precision is not required, and essentially the same procedure is used as in finding the position of a ship at sea.

If we are on the earth's equator at a time when the sun is in the celestial equator, the sun would pass exactly through our zenith and we could verify the fact of our being on the equator by measuring the altitude of the sun as it passed the meridian.

If the altitude measured a little less than 90°, we would know that we were not exactly at latitude 0° but as much north or south of the equator as the difference between our measurement of altitude and 90°. If we wanted to find the latitude of the place we happen to be today, we could do the same thing. The only difference would be that the sun is not on the equator and would not pass so close to the zenith. That need not disturb us any as we always know exactly how far the sun is from the equator, and this can be used as a correction.

The longitude of a place is only the difference in time between our local meridian and that of Greenwich. We have then only to know these two times simultaneously and take the difference. The local time may be found in several ways. The simplest way, but not the most accurate, is to observe the moment of greatest altitude of the sun. A better way is to observe the altitude of the sun at some distance from the meridian and then knowing, or assuming, a latitude, compute the hour angle of the sun, which is the local time. The Greenwich time can always be had from

the time signals broadcast by the Naval Observatory nearly every hour of the day. Therefore by taking the difference between the Greenwich time and our local time we may get the longitude.

The latitude and longitude may both be obtained from two observations of the altitude of the sun, if the two observations are separated by a considerable interval of time.

The sun shines on half the earth *all* the time. At sunrise today the altitude of the sun was 0°. It was also 0° for any place on a great circle around the earth, the only difference being the direction of the sun from the point of observation. We might say nearly the same thing if we take some other altitude than 90°, say 40°. When the sun has an altitude of 40° here, there is a circle on the sunward side of the earth from any point of which, the altitude is 40°, but the circle is not a great circle. For any Greenwich time we can compute what the altitude of the sun is for any latitude and longitude. This involves only the solution of a spherical triangle, the sides of which are (1) the distance from the pole to the zenith, known from the latitude of the place, (2) the distance from the pole to the sun, known from the sun's declination, and the distance from the zenith to the sun, which is the quantity sought. The angle at the pole is the local time which is known.

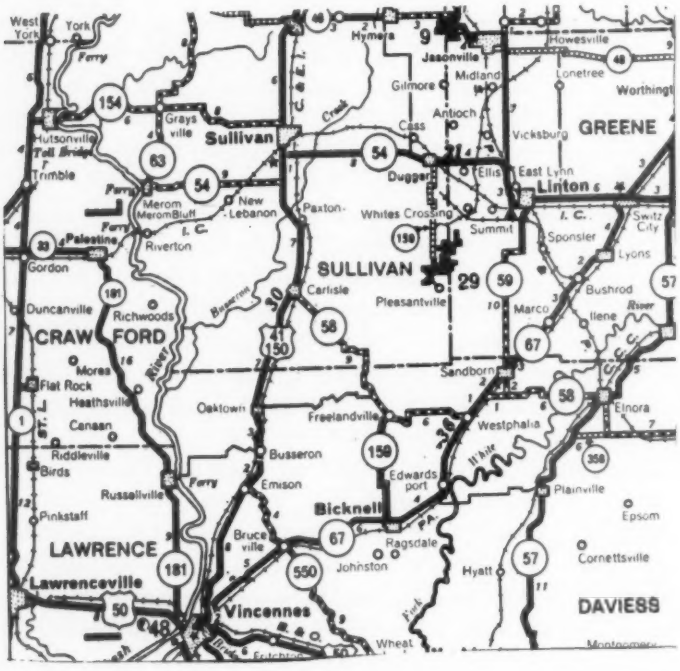
I might then for an assumed latitude and longitude (preferably in my vicinity) measure the altitude of the sun at exactly 9 A.M. today. I could then compute what the altitude should be for the same time. The difference between the two will be the distance in arc on the earth that I am from the position assumed, and this observation will allow me to draw on a map of the locality, a portion of the circle referred to above, from any point of which the sun would have that same altitude. A small part of the circle would be essentially a straight line and would run at 90° to the direction to the sun.

I have then on the map, a line on which my observation shows I was situated, but I do not know on just what part of the line I am. I do the same thing, say at 3 P.M. The two lines will intersect at my point of observation, since I am on both of them, and the scale of the map will show just how far this point is from the assumed latitude and longitude.

Of course the same procedure is good for any other object in the sky whose position is known and there are many hundreds of them. In getting the position of the center of population, the

latitude and longitude is furnished by the Census Bureau. From any good map this is shown to fall a little east and south of Carlisle, in southern Sullivan County, Indiana.

I then went to a point in this neighborhood from which I could see a good deal of the sky and made observations of the altitude of the sun from about noon until the sun was too low to see well. After the sun was down, the same thing was done for a number of the brighter stars. Each of these gave me a line on



Carlisle is about 6 miles from the Indiana-Illinois State line and about 73 miles from Kentucky on the south. From Carlisle by automobile the distance is 353 miles northeast to Detroit, 222 north to Chicago, 170 miles southwest to St. Louis, and 170 miles east to Cincinnati.

the map, the lines running in all sorts of directions, and each intersection was a determination of my position. I used thirty-seven such intersections, and the mean of all of them when marked on the map, showed that I was about a half mile south and west from the position given by the Census Bureau.

Of course if all observations had been exactly right and the time known exactly, these lines would all intersect in the same

point. Such precision is not possible with a sextant. Watching the star in the telescope, which takes both hands, and reading the second-hand of a watch by a flashlight at the same time requires more eyes and more hands than one person has, so the intersections are scattered over an area of a mile or more, but we trust to the elimination of accidental errors by taking the mean of a large number.

A MATHEMATICS TOURNAMENT

BERNARD FRIEDMAN

A great deal of student interest in mathematics was aroused when Wilson City College, Chicago, Illinois, held a mathematics tournament for high school students on April 30, 1942. Invitations were sent to fourteen high schools to select four students as contestants in the tournament. Thirteen schools responded. In one school interest was so keen that the school had to run an elimination tournament to select four contestants from among the thirty-nine applicants.

At the contest each student was given a mimeographed sheet containing three problems to be solved. A time limit, from $3\frac{1}{2}$ to 5 minutes, depending on the difficulty of the problem was set. The problems were read and the signal to start work was given. After the time limit was up, worked was stopped and graders marked the answers right or wrong. No part credit was given.

After the first set of problems were completed, another group of three was given. As soon as a contestant had five problems wrong, he was automatically eliminated. The contest continued until there were only two students left. These were awarded first and second prize. Minor prizes were given to the best student of each high school.

The problems required only one and one-half years of algebra and one year of geometry. Here are a few samples:

One of the equal sides of an isosceles triangle is 15. The base is 18. Find the altitude to one of the equal sides.

The cruising speed of an airplane is 150 miles per hour. It carries enough gas for a five hours' flight. How far can it go and return if it starts out with a 10 mile an hour tail wind?

Factor $6x^2+2xy-3ax-ay$.

NO DICTATION

"The armed forces wish to disrupt the civilian institutions, including the colleges and universities, as little as possible. For the most part, they do not desire to dictate to the colleges what they should teach. They have a high respect for what the colleges have been attempting to do in the past and encourage the continuance of a high type of educational experience. They look to the colleges to provide good, sound, general education. How that can be provided most effectively and in the shortest possible time is now the major problem before the college administrator."—*Higher Education and National Defense*, February 28. American Council on Education.

DOMESTICATION OF THE HORSE

HELLEN AUFDERHEIDE
School 54, Indianapolis, Indiana

Amherst College, Massachusetts, possesses an interesting fossil exhibit showing how the horse (*Equus caballus*) has grown and developed in North America during the past 6,000,000 years.

The earliest fossil shows him to be a small four-toed creature about the size of a jack-rabbit. The second fossil shows him the size of a Collie dog with three toes all of which touched the ground as he walked. The third specimen shows him much larger in size with only one toe on the ground. The two side toes hung at the sides are small and useless. The fourth fossil shows him about the size of a Shetland pony, with the side toes gone and only "splints" left representing the original second and fourth digits. The fifth skeleton is that of the horse of today.

As the toes decreased in number and the body increased in size, the teeth became steadily harder and harder. So, over the long epochs of time, he grew gradually from the small creature feeding upon the succulent plants of the lowlands, into the large and fleet animal, feeding upon the grasses of the hard prairie lands.

In Europe this same evolutionary story is told in the fossils found, but there, as in North America, he had disappeared before man had domesticated him. In Asia, however, he seems to have lived on in spite of the wolves which were perhaps his worst enemy, until the time of the cave men who hunted him for food up until the time when they began to settle down to a life in one locality. It was then that they began to provide food and care for the wild horse in return for the meat he furnished and later on for the services he could render. Thus began his subjugation.

That this subjugation began ages ago is learned from the fossil bones found in the remains of the Lake Dwellings of Switzerland which are believed to date back to somewhere near 5000 B.C. These domesticated horses resembled to a marked degree the wild horse (*Equus Przewalskii*) which was discovered in 1881 roaming in herds over the Zungaria desert of western Mongolia.

The horse seems to have been quite a finished animal even long before his subjugation for in certain caves in France and Spain have been found drawings of horses made by the artist-

hunters of the Late Paleolithic Age. These drawings date back perhaps as many as 20,000 years beyond the time of the Lake Dwellers. They portray a horse that not only resembled those of the Lake Dwellers but also bore a marked resemblance to the wild Mongolian horse of today.

Some scientists are inclined to believe that this Mongolian horse is not a truly wild form, but one escaped from domestication—a feral type. But if it is a truly wild horse, as others believe, it may be called the aboriginal form, the connecting link between the fossil horse of old and the horses of today. Some cannot see how the many different breeds of modern horses could descend from one such form. Yet it is well known that horses living in cold countries where food is scarce and living is rigorous, if given abundant food and good care, do increase within a short period of years in both size and appearance. It is reasonable to believe, therefore, that over a long period of time, they could become so changed that they would not easily be recognized for the same breed.

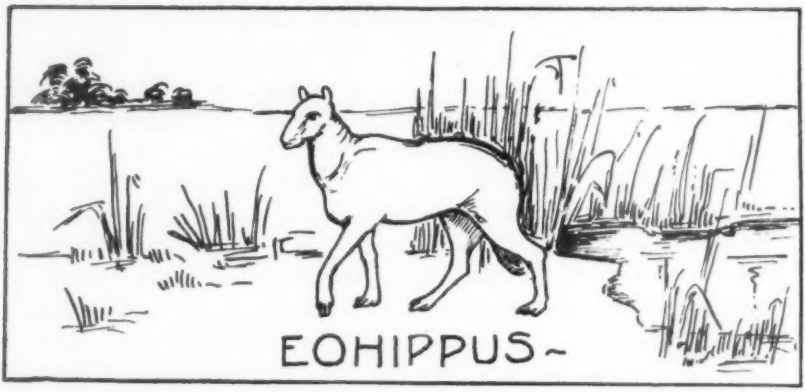
It is also believed that their domestication took place somewhere in or near the dry uplands just west of the Himalaya Mountains in central Asia. From here they were, no doubt, taken to the rest of the eastern hemisphere by the migrating hordes as they left their ancient homes in the highlands and moved farther and farther away in search of new lands and new homes.

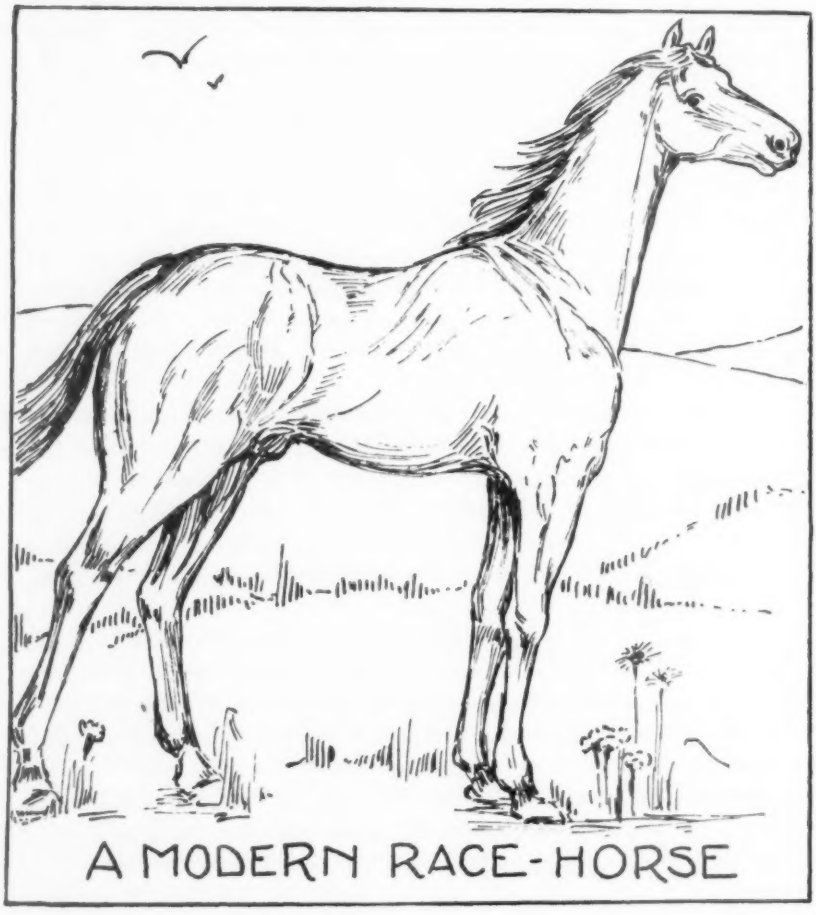
Greek mythology is full of references to the horse showing that he had long been domesticated in Greece as well as in the surrounding lands. He played an important part in the siege of the ancient city of Troy which occurred about the beginning of the twelfth century B.C. He was honored by being placed in the sky as one of the largest of the constellations, that of Pegasus, so familiar to all.

It is of no little interest to note that the horses used by the Greeks, as shown by carvings on the Parthenon 400 B.C., bore a close resemblance to the present wild horse of Asia "in size, in the shape of the head and in the peculiar short upstanding mane."

In the East from still earlier times the horse was not only known but was typical of power and splendor. As represented in sculptures and bas-reliefs he was similar to the horses of Greece.

Horses were not known in Egypt, however, until after the





Drawing by Dr. Esther M. Whitney, Central Normal College, Danville, Ind.

reign of the Shepherd Kings (about 1800 B.C.). This was after their contact with the Assyrians. Horse breeding then became of great importance among the Egyptians but the horse never "enjoyed sacred honors" there as did so many other animals.

In all probability the horse was known to the Phoenicians at a much earlier date. These ancient traders are also believed to have carried the horse to England centuries before the Christian era, where it was found by Caesar when he landed there in 55 B.C. He wrote of finding the natives using a small-sized horse with great skill. These horses were compelled to forage for themselves and were rounded up only when some were to be selected for use or for breeding purposes. It was these small horses that formed "the foundation" stock for the horses of Great Britain on which from time to time superior blood was grafted, resulting in the development of several distinct and famous breeds, as the Thoroughbred (race horses), the Hackney (harness horses), and the powerful Suffolk and Clydesdale breeds (draft horses). Those horses that were left out to forage in the open, however, without care or protection remained small and undeveloped. Their descendents make up the pony population of Great Britain today.

Since Arabian and Barb horses have one vertebra less than most other breeds, some naturalists claim two distinct lines of ancestry for the horses of today, (1) the African, comprising the Barb and Arabian races, and (2) the Asiatic, comprising all other breeds.

Libyan tribes are known to have possessed horses long before the Arabians did and it is entirely possible that these African horses reached Arabia through Egypt and became the progenitors of the Arabian line.

Others claim as many as five lines of ancestry: (1) The Mongolian wild pony—progenitor of the Chinese and Mongolian breeds as well as the Norwegian, and Irish ponies. (2) The Tarpan, a larger form that up to 1880 roamed wild over southern Russia—progenitor of Nubian, Greek, and Assyrian breeds. (3) A still larger type with a "Ram's nose" of central and southwestern Europe—progenitor of the draft horses. (4) The Barb and Arabian. (5) A small wild type of northern Europe now represented by the Shetland and kindred breeds.

Still many other naturalists believe all horses have descended from one primitive type. If this is true, then our numerous present varieties must be the result of moderate climate, good food

and care, plus careful selection and breeding over a long period of time for certain definite characteristics.

Ages ago man saw the advantage gained in war by the use of horses. He saw that the better mounts an army had, the more highly superior was that army. So he early learned and practiced the art of breeding. During times of peace when farmers needed better horses the draft type was developed. Men with many fine horses were long ago tempted to pit their favorites against another's in speed and strength, so chariot races and later tournaments were instituted. These, and other fads, forced breeders to develop highly specialized types such as the race horse, the hackney, the draft, and the saddle horse.

Structurally, the horse has changed little since his domestication, but he has increased in size, in strength, in speed, and in appearance. Since his domestication he has also developed a new gait, the trot, which has become the instinctive one with some breeds. His original natural gaits were the walk and the canter. Now, many of the high-bred saddle horses have not three, but five gaits, any one of which they take at the direction of the rider—a tribute to training and breeding.

PAMPHLETS TO HELP THE SCHOOLS ORGANIZE FOR PRESENT DEMANDS

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ROBERT FORTENBAUGH BOWMAN

It is with deep regret that we announce the death on April 22, 1942 of Mr. Robert Fortenbaugh Bowman, Vice-president of The Blakiston Company.

MATHEMATICS AND CONSERVATION IN NATIONAL DEFENSE

"SAVE THOSE TIRES"

MILTON O. PELLA
University High School, Madison, Wisconsin

In light of the very definite shortage of rubber it seems desirable if not imperative for us to present situations that will lead the students to see the need of conservation and to consider some possible methods of conservation.

The objectives of mathematics may be fully realized if this method of departure is employed.

In the following unit we are aiming at the teaching of use of fractions, decimals, percentage and interpretation of charts and graphs. The problems herein included are based on accurate data, most of which have been accepted by the motor vehicle department of the state of Wisconsin and the A.A.A.

INTRODUCTION

There are about 32,000,000 cars and trucks in the United States. If we consider that there are four tires on each automobile we get a sum of 128,000,000 tires in use by the people of this country. There are 130,000,000 people in the United States which would show us that there is about one tire for each person.

It has been estimated that if each driver would save 2 ounces of rubber on each tire (8 ounces for 4) per month that there will be saved 8,000 tons of rubber per month for defense needs.

There are many factors which are known to effect tire mileage. Some of these are: inflation, speed, temperature, skidding, faulty brakes, wheels out of alignment, overloading, etc. Each of the following problems begins with the presentation of data. You are asked to draw conclusions from your own mathematical calculations. For example: A motorist finds that he has been running his tires with a pressure of 21 pounds per square inch and the required pressure is 30 pounds per square inch. How many pounds under inflated have the tires been? What per cent were they under inflated? If for every 9 pounds underinflated the tire is run the mileage drops 25%, how many miles would a man receive from a tire which would ordinarily go 20,000 miles?

These problems provide a variety of opportunities for various

grade levels. It is possible to use some phases of them in each grade level from grade 4 through 10.

We may also use the graphs provided in teaching graphic interpretation especially at the upper grade levels.

The teacher must provide for individual differences in mathematics so that the problem will be meaningful to the student. The problems suggested in this unit are especially adaptable for the above purposes.

Problems Involving Percentage

Experimental evidence shows that:

When air pressure is down 30% the tire gives only 75% of its mileage.

Problems Involving the Effects of Under-inflation:

1. The required air pressure of a particular tire is 35 pounds. What is the air pressure when it is 30% under-inflated?
2. The required air pressure of a 6.00×16 tire is 33 pounds. What is the air pressure when it is 30% under-inflated?
3. The required air pressure of a 6.50×15 tire is 28 pounds. The motorist has the tires inflated to 20 pounds. How many pounds under-inflated are they? What per cent under-inflated are the tires?
4. A motorist owns a car which has 7.00×15 tires on it and he carries 24 pounds pressure in them. The required pressure is 30 pounds. What per cent under-inflated are these tires?
5. If your father keeps his tires 30% under-inflated, how many miles will he receive from a tire which would ordinarily go 20,000 miles?
6. Mr. Jones keeps his 5.50×17 tires inflated to 70% of the required pressure and receives 14,000 miles from them. How many miles would he probably get if he kept them properly inflated?
7. If Mr. Jones had maintained the proper air pressure in his tires, what per cent of the possible tire mileage might he receive.?
8. Mr. Smith's car has 6.25×16 tires on it. The required air pressure is 28 pounds for this tire, Mr. Smith keeps his tires inflated to 22.6 pounds. If his tires would give 24,000 miles with proper care, how many miles may he expect?

Conclusions

The conclusions are to be drawn by the student as a result of the above problems and their solution.

Problems Involving Fractions

Experimental evidence shows that:

When a tire is inflated to 7/10 of the required pressure the mileage from a tire is only $\frac{3}{4}$ of the possible mileage.

1. John's father owns a car which has 5.50×16 tires on it. A tire of this size requires 30 pounds of air to be properly inflated. If John's father keeps his tires 7/10 inflated what is the air pressure in the tires?
2. A 5.50×16 tire on a particular make of car requires 32 pounds pressure to be properly inflated. If the tire is inflated to only 24 pounds, what part of the required pressure is this?
3. Mary's Uncle has a car which has 6.00×16 tires on it. The required air pressure is 33 pounds and you may expect 20,000 miles from them if they are properly cared for. How many miles may Mary's Uncle expect if he keeps them inflated to only 7/10 the required pressure?

4. Helen's brother Harry has a car which has on it 5.50×17 tires. This tire requires 35 pounds of air to be properly inflated and would be expected to go 18,000 miles Harry keeps his tires inflated to 24½ pounds. How many miles will he loose from his tires?

5. A man receives 16,000 miles from a tire which is meant to give 20,000 miles. What part of the total mileage does he receive? What part of the total possible mileage did he waste?

(These problems may be revised so as to furnish materials for the teaching of decimals.)

Problems Involving Algebra

Experimental evidence shows that:

When the air pressure of a tire is down 30% the tire gives only 75% of its possible mileage.

1. A man puts two new tires on his car at the same time and later found that one tire wore out before the other. Tire A was properly inflated and gave more miles than tire B which was always 30% underinflated. The sum of the mileage on the two tires was 35,000 miles. How many miles did he receive from each tire?

2. Mr. A purchased 4 new tires for his car. He did not know how much air was required in them so he kept them inflated to 21 pounds for 12,000 miles. At this time a tire specialist told him that they should be inflated to 30 lbs. The tires were completely worn out at the end of 20,000 miles. How many miles might he have received if he had kept them properly inflated?

3. Mr. A. and Mr. B. each purchased a set of tires of the same make for their respective cars which were also of the same make and model. These two men drove on the same roads. Mr. A kept his tires properly inflated (35 lbs) and Mr. B inflated his tires to 24.5 lbs. Mr. A's tires went 4,000 miles more than Mr. B's. How many miles did each receive from his tires?

Experimental evidence shows that:

Tires wear out 62% faster at 70 miles per hour than at 50 miles per hour.

1. Draw a graph showing the increase in wear with an increase in speed.

2. If a man drove his car 70 miles per hour most of the time what mileage is he likely to receive from a tire which would give 16,000 miles at 50 miles per hour?

3. A man receives 14,000 miles from a tire driving at the speed of 70 miles per hour. How many miles would he be likely to receive if he drove 50 miles per hour?

4. What would you judge is the speed a man drives if he receives 12,400 miles from a tire meant to give 20,000 miles at a speed of 50 miles per hour?

This table based on 1,000 mile journey. Average car, average road, average driver. Does not include economic cost of accidents, which rises in proportion to speed.

1. From the above table compare the cost per thousand miles of tires at 25 miles per hour with that at 35 miles per hour. What is the actual difference? For each 1 mile per hour increase in speed how much does the cost of tires increase?

2. Repeat the above for the difference between 25 miles per hour and 45 miles per hour. 55 miles per hour. 65 miles per hour.

3. How much does it cost per mile for tires to drive at 25 miles per hour? 35 miles per hour? 45 miles per hour? 55 miles per hour? 65 miles per hour?

4. Compare the costs per mile at the various speeds. Draw a graph illustrating your findings.

5. What is the per cent increase in cost from 25 miles per hour to 35 miles per hour for tires?

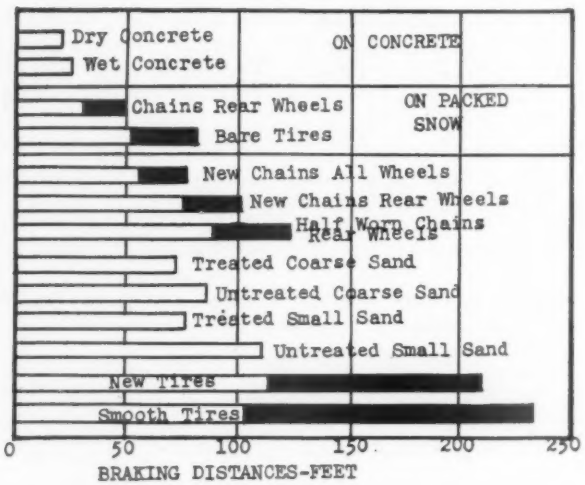
COST CHART BASED ON 1,000 MILES OF TRAVEL*

Miles per Hour	Gasoline	Oil	Tires	Maintenance	Total Cost per 1,000 Miles	Total Cost per Mile
25	\$ 8.75	\$ .15	\$ 1.50	\$ 4.00	\$14.40	$1\frac{4}{10}$¢
35	\$ 9.60	\$ .25	\$ 3.00	\$ 5.00	\$17.85	$1\frac{3}{4}$¢
45	\$10.50	\$ .40	\$ 4.50	\$ 6.60	\$22.00	$2\frac{1}{5}$¢
55	\$12.10	\$ .75	\$ 7.50	\$10.00	\$30.35	3¢
65	\$14.00	\$1.15	\$10.50	\$13.00	\$38.65	$3\frac{9}{10}$¢

* Table prepared by the Travelers Ins. Co. Hartford, Conn.

6. What is the per cent decrease in cost of tires when the speed is reduced from 65 miles per hour to 35 miles per hour? Why should we drive at a reasonable speed?

BRAKING DISTANCES FROM 20 MPH UNDER VARIOUS ROAD CONDITIONS IN LAKE CADILLAC TESTS



In the above chart, the solid black sections of the bars represent ranges of performance. On packed snow the ranges are for surfaces of different conditions. On ice, the ranges for bare tires represent variations in performance from dry to wet ice, while with changes the ranges are due to various types of chains. Performance with abrasives was uniform on dry and wet ice.

1. From the above graph answer the following questions.
   a. Under what conditions does the car stop the quickest?
   b. Under what conditions does the car travel the farther before it stops?

c. Compare the stopping distance when new chains are used with that when no chains are used on new tires.
d. Compare stopping distance between treated and untreated coarse sand.
e. Compare the stopping distance between new tires and smooth tires.
f. How far do each of the cars travel before they stop in each of the above cases?

Here are some other statements of facts which may be used as source material for problems in mathematics at various grade levels:

1. When wheels are $\frac{1}{2}$ inch out of alignment the effect is equivalent to dragging the tire sideways 87 feet in each mile.

2. Stepping hard on the brakes at a mere 35 miles per hour will wear off enough rubber to carry your car 1 road mile.

3. The average motorist drives 8,800 miles per year. By observing the rules of care of a tire an additional 2,200 miles of wear can be had from your tires. This is 25%.

4. At 50 miles per hour there is a two ton centrifugal force tending to pull your tires apart.

5. Hitting curbings or other sharp objects may break the tire thus ending its active life prematurely.

6. Tires should be switched around on the car. The left rear (receiving 29% of the wear) goes on the right front, (receiving 19% of the wear), the left front (receiving 14% of the wear) goes on the right rear (receiving 38% of the wear). They should then be shifted from right front to right rear, etc. This should be done every 5,000 miles. The life of a tire can be increased 25% by employing this precaution, all other things remaining equal.

7. In an average month 4,000,000 tires were sold. The January quota of new tires is 356,974 or less than 1/10 as many.

8. A tire makes about 15,000,000 revolutions in 20,000 miles. About 700 revolutions per mile.

9. Each motorist wastes about one tire in five because of under inflation.

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Materials may be obtained from any tire advertising bulletin and much from insurance booklets.

THE ROLE OF CONSERVATION AND SYMPATHY IN NATURE STUDY*

J. E. POTZGER
Department of Botany and School of Education, Butler University, Indianapolis, Indiana

The importance of nature study in a modern school need no longer be emphasized, that phase of the work had its alpha and omega in the past. Convention addresses, articles in school magazines, in various science journals, and books innumerable have also beaten a wide path into the field of teaching procedure. True, there is still need for repetition of good methods, and value in listing additional aids in the presentation of the subject matter, but two important phases of nature study, which acquaintance with and information about life forms and phenomena in nature do not necessarily generate in the student, i.e., a spirit of conservation and sympathy for specific life forms have, perhaps, been quite universally overlooked. Civilized man, while a part of the biotic phase of our world, has by power of reason divorced himself to a major degree from the laws of nature which direct towards equilibrium and balancing between biotic forms themselves and with their physical environment. Thus civilized man has become a disturbing element in the balancing process, and has become a taskmaster under whom all biotic forms suffer directly from killing or indirectly by the disturbance of their balanced habitats.

Most life forms are not cruel in the sense in which man is cruel, most other forms kill and destroy only when demands for food and need of protection stimulate the urge; man has expanded this primitive urge to destroy either for food or for protection to the limitless killing for "sport," or for the unreasonable superstitious fear of harm from perfectly harmless life forms. Sears in his book *Deserts on the March* has pointed out that civilized man by power of reason has exploited resources of nature to an extent that today the gaunt spectre of deserts stalks where only a few centuries ago nature had a balanced life relationship which made possible luxuriant and abundant plant and animal life. Driven to extremes, such wanton and non-conforming use of nature's resources eventually become the Nemesis which drives man poverty-stricken from his ancient

* Portion of an address before the section on Nature Study of Indiana State Teachers' Association, Indianapolis, Indiana, October, 1941.

habitation, or throws him into want and menial existence in a depleted and exploited environment.

As stated previously, teaching of biology has progressed beyond the mere acquainting of students with forms and functions, and we should today fit this knowledge into the frame of balanced laws, and show relationships between organisms themselves and with their environment, and above all must we show the part man plays in this relationship, and should play in a balanced nature. It is not the intent of this short article to follow all the ramifications of conservation, nor to list the numerous laws which must be observed if we are perpetually to take more from nature than the mere necessities of life. The writer, however, feels that a biology course of today should involve at least the more obvious fundamental laws and facts of conservation in order to train a generation able to subjugate greed and ignorance to a restraining cooperation with well-directed conservation suggestions and movements. To this end a limited list of publications is appended which deserve a prominent place in every biology teacher's library. I will, however, in this article point out a few conservation needs which are frequently associated with the teaching process itself.

Conservation

The study of spring flowers very frequently includes an assignment that collections be made of wild flowers, in some instances the demands have included from 100 to 200 different flowering plants. If junior and senior high schools, perhaps even the grade schools of a community, even though it be a village with apparent abundant woodlots at close range, make such a requirement it will necessarily result in the extermination in a few years of the more rare of our wild flowers. One teacher told me last fall that such practice had stripped the entire countryside about a certain village of all but the most prolific reproducers of the spring flowers. Such teaching of biology defeats its own purpose, and fails to instill the most important factor of appreciation without destruction. In order to conserve these plants they must be studied only on supervised field trips, or from single collections made by the instructor. If wild flowers are pressed neatly, placed under cellophane and mounted on cardboard, they can be observed more frequently and more scientifically than if children merely make a mass collection of the flowers. One Indianapolis teacher hinges two pieces of thick

cardboard by rings of stout cord and fastens the specimens with gummed cloth strips to one of the pieces of cardboard. This permits display of the plant as on an easel, or to be hung on the wall. After the plants have been studied the two pieces of cardboard can be folded and thus protect the specimen while in storage.

Wherever possible, a school should develop a wild flower garden where the most common plants could be observed and studied without destruction. Any procedure of study is, however, preferable to the one involving wholesale collections by the student. What has just been said about collections of wild flowers does not apply to collections of leaves and insects, in these latter cases collections do not involve the danger of extermination.

Our nation has frequently been adversely criticized for its lack of esthetic sense in the use of public places and property of neighbors. Just a casual observation will readily support such criticism. We litter our city streets, highways, parks, woodlots, lake and river frontage, and the water bodies themselves with newspapers, empty cans, wrappings, bottles, and the like. Eventually this will mean expense to public service organizations to clean up, or the places become too filthy for any future recreational activity. Field trips offer a fine opportunity for practical training in the conservation of recreational areas by proper disposal of waste materials. At every field trip lunch or dinner a box should be provided for the collecting of scraps and wastes so these can be taken home for proper disposal. Never miss the opportunity to stress the need of such conservation procedure after a meal in the outdoors.

Sympathy

"There's naught in this bad world like sympathy," says Byron; and while he referred to a sympathetic interest of one human being in troubles of another, we can augment the field of application readily to include lower life forms as well. Life is life in whatever form it moves, and it shrinks from destruction and death in simple beings as it does in our own body. Have you ever paused a moment in your biology lessons to meditate a bit on the phenomenon of life to shrink with horror from death? It is a sad obligation if we must kill to defend our existence or to insure our own life, but even in this age of biology information there is too much unreasonable killing motivated by antipathy

and superstitious fear. I will list here but two life forms which bear the brunt of this antagonism, snakes and toads. It seems to the writer that in view of the repulsion which so many persons feel towards these two animal forms, special effort should be made in biology classes to break down the cruel persecution which they must suffer because of unreasonable ignorance. Even in our enlightened age many persons still believe that a toad produces warts on the hands of the person touching its body, and that snakes sting with their mobile, forked tongue. Such deep-seated superstitution is not eradicated by mere reference to real facts in the course of a biology lesson, it requires special effort which could best be given added weight by the presence of a toad or garter snake in the classroom, where daily association with, feeding, and even bodily handling would build up a more favorable set of concepts about these animals. The pearly eye of the toad radiates friendliness, beauty, harmlessness and a trust in man expressed by few other animals. In the niche into which nature has fitted this great friend of man, the unattractive body and color serve a definite purpose to a specific end. I plead the cause of our benefactor, the toad.

The case is not quite so simple with the snakes, for among their clan are some which possess an effective hypodermic needle filled with deadly poison which they frequently use with poor discretion. In this group we must select and discriminate, which after all is an easy matter. Yet the writer has seen classes in biology watch with fear-dilated eyes a perfectly harmless garter or water snake make desperate effort to escape to a place of safety, and volunteers for executioneers of the poor reptile were never wanting. Snakes are beautiful, and only the distorted conceptions built up from Genesis 3:1, folklore, hyper-imaginative stories, accounts in newspapers have left in the minds of most persons the impression that all snakes are the common enemy of man. The obligation of the biology teacher is to instruct well in the characteristics which separate the venomous from the harmless species, which for most of the area east of the Mississippi, and north of Virginia is a small matter. Every class in biology should have opportunity repeatedly to see and examine preserved specimens of both the copperhead and the rattler. From lower Indiana southward it is essential also to teach the differences between the water moccasin and the harmless water snake.

We are today the ruling race of beings, and by aid of inven-

tions we can only too easily exterminate the larger life forms. May our antagonism and primitive lust to kill be controlled by reason, and filter through a screen of conservation and sympathy. To build up such an attitude in coming generations is a vital obligation of every biology teacher.

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ELECTROLYSIS OF SALT SOLUTIONS

W. A. PORTER
University High School, Madison, Wisconsin

Many students in chemistry find difficulty in understanding the reactions which take place in the electrolysis of salt solutions. Before studying the preparation of NaOH, I find the following demonstration a valuable introduction to the topic.

A simple electrolysis apparatus is set up as in Figure 1 using a solution of NaCl as the electrolyte.

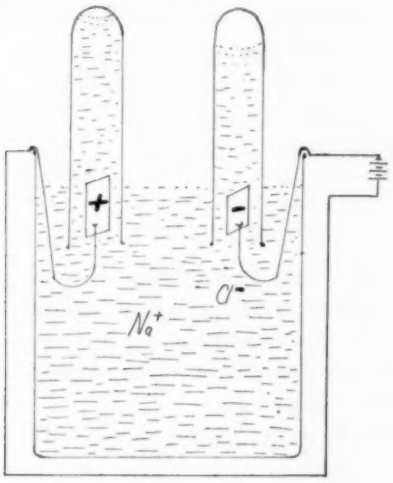

FIG. 1. Electrolysis of sodium chloride solution.

The test tube which is inverted over the negative electrode is filled with a salt solution to which has been added several drops of phenolphthalein solution. The other tube is filled with a salt solution to which has been added some blue litmus indicator. The salt solution is thus tested with both an acid indicator and a basic indicator.

The students are then asked to state what ions may be present in the solution. It is easily seen that there may be Na^+ ions and Cl^- ions but not enough H^+ or OH^- ions to affect the indicators. The current is then turned on and immediately the solution around the negative electrode becomes red which indicates the presence of OH^- ions. The blue litmus in the other tube changes to red and then becomes colorless as the indicator becomes oxidized. This change indicates the presence of H^+ ions. As the

electrolysis continues the tube over the negative electrode fills with a gas. When it is full it may be removed and tested with a lighted splint. The characteristic pop indicates the presence of hydrogen gas. The other tube may now be removed and the presence of chlorine indicated by the odor and color of the contents of the tube.

The students now have seen the evidence that hydrogen and OH ions were formed at the negative pole and chlorine and hydrogen ions formed at the positive pole. It takes very little prompting for them to arrive at a logical explanation of the nature and the sequence of the reactions that occur in the electrolysis of NaCl. The demonstration creates greater interest because it offers a challenge to the students to explain what has happened and provides an opportunity for inductive thinking, rather than a rote memory exercise.

Sources of Current for Electrolysis Demonstrations

In order to carry on electrolysis, electroplating and many other demonstrations in science, some source of direct current is necessary. This power source should have a voltage of not less than 6 or more than 20 volts. The current should be variable from 0 to about 5 amperes.

Perhaps the most simple source of power is a battery of 4 to 6 dry cells connected in series. This arrangement supplies an adequate voltage and sufficient current but is somewhat expensive. The cells also lose their strength upon standing.

Another source is the common storage battery or car battery. This device furnishes a potential of six volts and a large amperage. Since the batteries may be obtained from any auto wrecking yard for a small sum and may be indefinitely recharged they are a desirable piece of laboratory equipment.

Probably the most satisfactory source of direct current is the small battery charger or "power stations" as they are called in apparatus lists. These devices consisting of a step down transformer and a Kuprox rectifying unit with a rheostat to control the current output, furnish a voltage of 6.5 and an amperage of from 4 to 6. The cost of the device is less than the new cost of a storage battery and since it does not deteriorate with age it is more economical than batteries and very much lighter and easier to handle.

Another source of direct current is an automobile generator

(from junk yard) and a washing machine motor (junk yard) to drive the generator. This combination will furnish 6 to 7 volts at a current drain of 15 to 20 amperes. A rheostat placed in series with the field supply will give a convenient current and voltage control.

The electrolytic rectifier may also be used. The circuit for the device is shown in Figure 2.

Since the rectifier has a low resistance some form of control must be added. The 100 watt lamp in series with the circuit

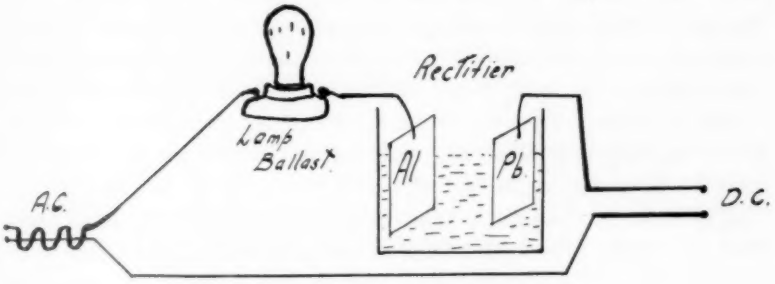

FIG. 2. An electrolytic rectifier.

limits the current to a convenient value. The aluminum plate should be large, pure and very clean. The electrolyte may be sodium ammonium hydrogen phosphate solution or ordinary borax may be used if the complex salt is not available. The concentration is not critical, 10% solution by weight being satisfactory. This device furnishes a pulsating direct current since only half of the wave is used. Also the device must be "formed" each time it is used. This is done by shorting the D.C. terminals for 5 minutes just before using.

WHERE TO GET INFORMATION ON TEACHING POSITIONS

Where can a teacher turn for information regarding teaching vacancies? To answer this question asked by thousands of teachers each year the U. S. Office of Education has prepared a guide to national and State teacher placement organizations and officials.

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Single copies of the circular are available free from the U. S. Office of Education, Washington, D. C. Its title is "Teacher Placement, Registration, Announcement, and Related Services, 1942." Circular 209.

THE DILEMMA OF VOCATIONAL MATHEMATICS

WILLIAM L. SCHAAF
Professor of Education, Brooklyn College, Brooklyn, N. Y.

Now that all out war production is increasing literally by leaps and bounds, interest in vocational mathematics is also reaching unprecedented heights. This impetus is obviously due to the ever increasing demand for courses in machine shop, mechanical trades and technology. The terms *trade mathematics, shop mathematics, applied mathematics, vocational mathematics, industrial mathematics, related mathematics,* and *technical mathematics,* as currently used, are rather ambiguous, being employed interchangeably with considerable attendant confusion. This situation alone, however, does not constitute the major problem. With appropriate definition of terms, questions of content, organization, and administration still remain to be clarified.

Standard practice in the vocational education field has come to regard its curriculum content as falling into two distinct areas: "practical work," and "related subjects" such as physics, chemistry, mathematics, and drawing. Related studies are further defined as comprising such material as is "inherent in the vocation taught, and which enlarges the trade knowledge of the worker." In this sense, therefore, "trade mathematics," or any course in which a sizable proportion of the content refers to specific trade information or practice, is to be regarded as synonymous with *technical, industrial, applied, shop* or *vocational* mathematics; all such courses are, or should be, distinctly different from a course in *general mathematics,* if this be given in a vocational or trade school. The general mathematics course in these instances, as the name implies, includes a body of mathematical knowledge and skills which are potentially of practical, utilitarian value, taught without direct reference to any *specific* trade or vocation, although obviously intended to lay a foundation for any and all common trades, and freely using illustrative material drawn from various trades, provided such illustrations require a minimum of specific trade information. That there are many mathematical concepts, relations and skills common to the various trades which make little or no demand upon the learner for knowledge of specific trade operations or equipment, is of course clear. To bisect an angle, to divide by a mixed number, to find a per cent of a quantity, to find the tangent of an angle, these and many others can be

illustrated by many trade problems requiring merely a verbal or pictorial description of the situation to make them understandable.

Trade mathematics, or *related* mathematics, on the other hand, is primarily concerned with the very real and specific problems pertinent to a given industry or trade. Such problems are an integral part of the technical content of the trade, and can usually be comprehended only in terms of that trade and solved by methods peculiar to it. These problems originate within the activities of a trade, and may be derived from the jobs or operations connected therewith; such job analysis can best be made by vocationally competent persons who have, in addition, a sound background in mathematical and quantitative relationships.

Hence, in view of the somewhat confused and misleading use of terms, and in line with current trends, it is recommended (1) that the term "related trade mathematics" be preferred to the multiplicity of synonymous terms mentioned above; (2) that the term "general mathematics" be reserved for a basic, introductory course in general *mathematics*, with an eye to no single trade in particular, but rather to a mastery and understanding of necessary mathematical concepts and skills; and (3) that all other names (such as those alluded to) be abandoned in the interests of clarity and simplicity. In short, *related trade mathematics* differs from *general mathematics* in both purpose and content insofar as the function of the former is to correlate mathematical learning with the manipulative operations and the processes of the shop, and to enhance the understanding of trade information and skills through the use of quantitative relationships involved therein. The distinctions and terminology set forth above will be observed in what follows.

The case for a uniform, basic, introductory course of general mathematics for all vocational students is fairly clear. Some few years ago K. E. Gaylord pointed out that "applied algebra" and "applied geometry" were highly specialized in each vocation, but that "mathematics does possess certain definite cultural and disciplinary values which are more helpful than the majority of the specific mathematical principles or processes per se"; such was the testimony of vocational workers themselves. He also found that, in descending order of frequency, the most useful topics of arithmetic were common fractions, simple interest and the measurement of areas and volumes; in algebra,

they were the solution of formulas, algebraic natation, and linear graphs; in geometry, the relation $C=\pi D$, the right triangle theorem, and similarity and proportion.

Approaching the problem from another angle, G. Joachim found that there were notable deficiencies in the conventional academic high school mathematics. "Students . . . have trouble in applying mathematics out on the job. Mathematics to them has been an impractical, blackboard proposition whose value or interest, if any, has ended when the student leaves the classroom." Because of this situation, as well as the inadequacy (until very recent years) of vocational mathematics courses, industrial concerns were obliged to conduct evening classes in practical mathematics or include a course in mathematics in their apprenticeship schools. One of the several salutary outcomes of this necessity was, of course, the attack from the standpoint of job analysis, concerning which something will be said below.

What, then, should the general mathematics course include? What are the required concepts and skills more or less common to all the trades—from machine shop to needlework, from woodworking to electrical trades? Obviously there will be some slight discrepancies when we consider the requirements of some fifteen or twenty different trades. But the following outline is perhaps suggestive of the scope and content of what would conceivably fulfill the purposes already suggested. In some vocational schools the "consumer mathematics" material might be deferred until the last year, although the advisability of doing so is at least problematical. The material here set forth might well be fitted into the first year's work of any vocational, trade, or specialty trade school, with from four to five class-periods per week devoted to the course. It is recommended that such a course be taught by "regular" mathematics teachers rather than by shop teachers, for obvious reasons.

Outline of a General Mathematics Course for Vocational Schools

FIRST HALF

I. Fundamentals of arithmetic
   1. Weights and Measures
   2. Measuring Instruments
   3. Fractions and Decimals
   4. Percentage
   5. Ratio and Proportion
   6. Powers and Roots

II. PRACTICAL GEOMETRY
- 7. Angles and Lines
- 8. Triangles
- 9. Polygons; Areas
- 10. Circles and Tangents
- 11. Geometric Constructions
- 12. Similar Figures
- 13. Mensuration of Solid Figures

III. ELEMENTS OF ALGEBRA
- 14. Letters and Numbers; Formulas
- 15. Positive and Negative Numbers
- 16. Exponents and Radicals
- 17. Equations and Graphs
- 18. Logarithms
- 19. Slide Rule

IV. ELEMENTS OF TRIGONOMETRY
- 20. Trigonometric Functions
- 21. Right Triangles; Projections
- 22. Oblique Triangles

SECOND HALF

V. BUSINESS PRACTICE
- 23. Ordering Goods; Invoices
- 24. Price Lists and Discounts
- 25. Transportation of Merchandise
- 26. Profit and Loss
- 27. Simple Interest

VI. HOUSEHOLD MANAGEMENT
- 28. Personal Accounts
- 29. Budgeting and Thrift
- 30. Installment Buying
- 31. Personal Insurance (Life and Accident)
- 32. Social Security
- 33. Taxes

VII. INDUSTRIAL ARITHMETIC
- 34. Cost Analysis (Materials, labor, overhead)
- 35. Wages and Pay Rolls
- 36. Inventories
- 37. Depreciation
- 38. Cost Estimating
- 39. Property Insurance
- 40. Workmens' Compensation

We come now to the most vexatious problem of all—the question of what is an acceptable scope and organization of the materials of instruction in the course in related trade mathematics. Let us examine some of the difficulties involved.

To begin with, many of the existing textbooks on shop mathematics, etc., including even recent ones, suffer from one or another of the following shortcomings: (1) they tacitly assume

a greater knowledge than the pupil possesses of concepts, operations and terminology inherent to the various specific trades; (2) they set forth a preponderant amount of material (notably formulas) which is presented entirely empirically, with no attempt at derivation or rationalization; and (3) they include considerable material that is too advanced or too difficult for the average vocational school pupil.

In the second place, instruction in related trade mathematics is frequently too theoretical or abstract, i.e., it is too often conducted as "book learning." To quote Joachim again: "the treatment should be from a practical standpoint both in discussion and in actual problems. . . . It should be remembered that the average [academic] mathematics teacher is not qualified to teach related trade subjects themselves. The related mathematics teacher is expected to teach his pupils the mathematics they will need to know in their respective lines of lifework. This material should be taught more from a laboratory standpoint rather than an abstract one. . . . Not only the method of teaching, but the situations taught, should be practical and related directly to fundamental experience. Present texts may be used, but the instructor should supply sufficient concrete laboratory practice to make sure that the student really learns the needed essentials. . . ."

It should be pointed out, of course, that the assertion that the average mathematics teacher is not qualified to teach related trade mathematics may very well be debatable. Be that as it may, however, the dilemma comes down to two sets of alternatives, each offering two alternative procedures. First: (I) should the related trade mathematics courses be offered and conducted by the department of mathematics, as courses in *mathematics*, or (II) should they be conducted by one or more trade departments, as courses in *shop work?* Secondly: If (I), then the further question: should these mathematics courses be taught (a) by a "mathematics teacher" or (b) by a "shop teacher"? If (II), then the further question: should the shop work in mathematics be taught (a) by the same teacher in the particular trade in the same class periods in which he teaches that trade, or (b) should it be given, by different teachers, in the form of parallel courses?

So far as situation (II) is concerned, it should be pointed out that where the same teacher teaches the shop work *and* the required mathematics in the same period, the following ad-

vantages obtain: (1) increased motivation and pupil interest, (2) more complete integration of content, and (3) enhanced functional learning (more effective transfer and retention). The possible disadvantages, however, have to do with adequate teacher preparation and additional time allowance. If, on the other hand, the shop work and the mathematics are carried on by separate teachers in parallel courses, we must face the difficulty involved in coordinating the content of the two courses and the risk of lack of motivation. Of these, the former is probably the more serious problem.

However, the chief hope of improvement lies perhaps in the fact that no inconsiderable progress has been made in recent years in this very matter of coordinating or integrating the work of the shop and the related mathematics in the same given trade, whatever that trade may be. Such desired integration is materially enhanced by means of job analysis. Among the early efforts to meet the needs of shop pupils were the studies made some years ago at the Cass Technical High School in Detroit, Michigan; the results of these analyses were incorporated in a number of well-known text books. Since then many similar studies have been made, both by the Federal Board for Vocational Education, and by graduate students in the field of vocational education. Today many of the common trades have been subjected to the technique of job analysis; the required mathematics involved in the various "jobs" and "operations" have been for the most part tabulated, and are reasonably accessible. They are to be found chiefly in government publications, in state and city syllabi and courses of study, in unpublished masters' theses and in doctoral dissertations, and occasionally in industrial publications. In particular, the trades that have been studied more carefully in this respect include: machinist trade, auto mechanics, electrical trades, carpentry and woodworking, sheetmetal work, plumbing, machine drafting, pattern-making and foundry.

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Jersey City, New Jersey

INTRODUCTION

It is the purpose of the following paper to briefly demonstrate that chemical topics have been used as literary themes from the days of alchemy to the present. Many esteemed authors have had a sufficient chemical knowledge to permit them to make various chemical allusions in their works. Among such authors may be mentioned Emerson, Goethe, Balzac and others. The scientific fantasy novel has now proceeded beyond dependence upon the realistic facts of modern science in order to romanticize concerning the future. The inception of this interest in the prospectus of the future lies far back in the 18th century.

It is exceedingly difficult to determine whether a novel or other literary work is based on a chemical theme or alludes to chemical topics without actually reading it as few of the existing library catalogs refer to novels by subject. It is therefore felt that the lists of novels and other literary works contained in this paper will prove of interest to the reader.

THE VALUE OF ALCHEMY

To his contemporaries the alchemist was a strange and solitary individual ever groping amidst the smoke and disorder of his laboratory. There, surrounded by alembic and talisman he ceaselessly sought the manifold powers of rejuvenation and transmutation. Alchemy in those days was regarded as a subject beyond the limbo of the proper and akin to sorcery and the adept was at various times feared and flattered, despised or courted depending upon circumstance. It is not possible to regard the alchemist as a victim of self-delusion based on ignorance. Many of the most enlightened men of the time were serious in their hermetic attempts. As a result of their labors a great deal of qualitative phenomena was amassed. As Schopenhauer says, "In their search for gold, the alchemists discovered other things—gunpowder, china, medicines, the laws of nature." From the empiricism of alchemy there slowly evolved by many painful steps the modern chemical science of today. Liebig does not hesitate to assert that "alchemy from first to last was chemistry."

The only charge that can be laid against alchemy is the hiding in many cases of discoveries and facts behind an almost impenetrable curtain of fanciful and bizarre terminology but when one considers that no facilities were available whereby discoveries could be published and protection given the author for his work it is only natural that the adept sought safety in the cipher, acrostic and deliberately vague language. Further, the very nature of the search for the quintessence made it imperative to hide the results from every other individual, for the power of one man to turn base metals into gold placed in the hands of many would render the operation profitless.

Apart from its utilitarian value alchemy claims its place in history as a great fountainhead of romance for it abounds in the fantastic, the uncanny and the marvelous. From the very earliest days of alchemy to the present time literature has occupied itself on countless occasions with themes borrowed from alchemy and the mysterious operations of the alchemist.

Alchemy in Early Literature

Early in the Middle Ages Aurelius Augurella employed the medium of verse in which to expound the mysteries of the hermetic art. Jean de Meung (1275), the famous author of the "Romance of the Rose," was a sincere believer in alchemy and makes it the subject of two of his shorter poems. "The Romance of the Rose" is an allegorical rendering of the secrets of the hermetic art.

The ancient association of metals with the days of the week has persisted to the present time as exemplified by such germs as "lunar caustic" for silver nitrate. This association figures prominently in medieval literature, the best-known reference being in Chaucer's *Canones Yeomans Tale:*

> The bodies seven, eek, lo heer anon.
> Sol gold is, and Luna silver we declare;
> Mars yron, Mercurie is quyksilver;
> Saturnus leed, and Jubitur is tyn,
> And Venus coper, by my fathers kyn.

John Gower (1325?–1408) in his verse assigns "the Brasse" to Jupiter.

Many readers consider *The Alchemist* of Ben Jonson (1573–1637) to be his finest work. It was published in 1610 and is a powerful satire aimed against the deceitful alchemist and the greed for gold of his intended victims. The play concerns a

butler named Subtle, who takes advantage of his master's absence from London to operate an extensive alchemical swindel with the help of two accomplices, Face and Common. Surly, the intended victim, is openly skeptical of alchemy and expresses his disbelief in the following lines:

> "Alchemy is a pretty kind of game
> Somewhat like tricks o' the cards, to cheat a man
> With charming . . .
> What else are all your terms,
> Whereon no one o' your writers 'grees with other?

Iatrochemistry and Literature

In the sixteenth and seventeenth centuries a group of chemists called Iatrochemists attempted to apply chemistry to the preparation of medicines and to the explanation of the bodily processes occurring in the living organism. Paracelsus was the founder of this school of endeavor.

Theophrastus Bombast von Hohenheim, commonly called Paracelsus, was born in 1493 at Einsiedeln in Switzerland. From his father he learned medicine. Paracelsus as a young man traveled about Europe furthering his education by studying mining, medicine and alchemy. In connection with the latter he believed in the philosopher's stone and in the elixir of life. He took the degree of M.D. at Ferrara in Italy and in 1527–8 he was appointed professor of medicine at Basel. His revolutionary theories and the denunciation of more conservative physicians won for him the envy and malice of his colleagues and a quarrel with a prominent canon over a professional fee made it necessary for Paracelsus to quit Basel. From this time on he wandered about Europe finally dying in straitened circumstances at Salzburg in 1541.

Doctor Faustus, a play written by Christopher Marlowe about 1589 is remarkable both as the chief work of the founder of English tragedy, and as the first play based on the Faust legend. It is not certain whether Valdes in this play represents Paracelsus. At the time of the Reformation there were many traveling scholars in Europe who paid their way by performing various tricks and wonders. The last of these traveling magicians to gain notoriety was John Faustus, whose public career lasted from 1510 to 1540. In 1587 the *Faustbuch* was printed, giving the story of his life and exploits. An English translation was probably the source of Marlowe's plot. Goethe was later to use the same

theme. The play consists of fourteen scenes without any grouping into acts.

Faustus, dissatisfied with the limited bounds of philosophy, resolves to enlarge his sphere by practicing magic. He conjures up Mephistopheles and bids him be his servant. In payment for this service Faustus agrees to surrender his soul after four-and-twenty years, if during that time Mephistopheles shall be his slave. Then Faustus sets out in search of knowledge and pleasure, traveling about invisibly. He performs many astounding tricks such as summoning Helen of Troy. Impressed by her beauty he quotes the famous lines:

> "Was this the face that launched a thousand ships,
> And burnt the topless towers of Ilium?
> Sweet Helen, make me immortal with a kiss!"

Eventually the time expires, and Faustus in agony awaits his doom. He appeals to God and Christ, but has forfeited the right to pray; and at the stroke of twelve Lucifer bears him away to everlasting doom.

Paracelsus is definitely identified in Samuel Butler's "Hudibras" which appeared in 1663. Paracelsus in life regarded the hilt of his sword as a talisman and this thought is expressed in the verse:

> "Bombastus kept a devil's bird
> Shut in the pommel of his sword,
> That taught him all the cunning pranks
> Of past and future mountebanks."

Robert Browning produced his dramatic poem "Paracelsus" in 1834. As the poet himself says he was not as concerned with the actual events of Paracelsus's life as he was with the psychological significance underlying them. In the poem we meet Paracelsus as a professor in Basel and are with him at his death in the Sebastian Hospital in Salzburg. Browning romanticized to the extent of having Paracelsus meet the poet Aprile in Constantinople after years of travel and disillusionment. The tragic conflict between knowledge and love is poignantly revealed in the closing lines of the poem.

Browning, it may be mentioned at this point, also gives some vivid chemical descriptions in his other works, notably in "The Laboratory."

Many years later the Vienna physician and dramatist, Arthur Schnitzler, took the life of Paracelsus as his theme. He stresses the medical work of Paracelsus and has one of the players, a

town-physician, describe the appearance of Paracelsus as he appears in the market place of Basel:

"He mocketh Avicennas, scorneth Galen,
Belittles all the men that were before him
And brought out art to this its lofty height;
Jeers at the school from which himself did spring,
Reviles the leeches and apothecaries;
And the good people's claps and cries to catch,
What think you that the shameless fellow does—
Does with the physick that sick men have brought him?
The draughts he poureth out upon the ground,
Far hurls the bottles from him into space,
And simply blows the powder in the air,
And shouts the while: A new Hippocrates
And more than that am I, I, Paracelsus,
And all your leeches are crabbed simpletons. . . . "

Max Geilinger in a recent realistic production, "A Play of Paracelsus" tends more toward presenting the historical aspects of his subject's life. Paracelsus, in describing his education says, "Not through everlasting turning of pages did I acquire my knowledge, but with the code of nature—so often a land, so often a leaf."

Chemical Experiments of Samuel Johnson

Many of the great literary figures have taken more than a cursory interest in chemistry. Henry Cavendish, the English chemist, made many experiments with hydrogen, which had previously been discovered by Boyle. Cavendish was a firm believer in the theory of phlogiston and did not realize that he had isolated, not the principle of fire, but pure hydrogen. There were many who would not accept this hydrogen as the real phlogiston and among the unbelievers was England's great literary genius Samuel Johnson. He busied himself with many chemical experiments and as Boswell says, it was "a life-long interest." Boswell entered in his diary that he sent Mr. Peyton to Temple Bar with definite instructions: "You will there see a chemist's shop at which you will be pleased to buy for me an ounce of oil of vitriol, not spirits of vitriol. It will cost three halfpence." He was going to prepare some hydrogen himself and investigate its properties.

Goethe and Chemistry

Goethe is renowned throughout the world of letters as the author of *Faust*. It is less well known that he was also a chemist of no little ability. Goethe's reputation as a chemist is based

upon the actual experimental work which he carried out and on the references to chemistry which appear at various places in his immortal works.

As a young man Goethe studied alchemical works and the writings of Paracelsus. His interest in iatrochemistry began with an illness that directed his attention to the universal medicine "Luftsalz" used by the physicians of that day. When Goethe went to Strassburg in 1770 to continue his study of law he became greatly interested in the industrial aspects of chemistry. In 1775 Goethe was called to the court at Weimar as a public administrator and in the course of his inspections performed many technical tests.

In 1786 Goethe visited Italy. On his return to Weimar he appears for a time to have considered giving up literature for science.

The continental blockade of German ports from 1806 to 1812 cut Germany off from a great number of much needed products formerly imported from England. At this period of his life, Goethe, in cooperation with J. W. Döbereiner worked on numerous problems from a synthetical viewpoint.

Goethe's interest in chemistry continued until the time of his death in 1832. As a result of his love for chemistry various aspects of that science are mentioned in his literary productions. The second verse of Act II of the second part of Faust describes an alchemist's laboratory.

Chemical Novels of the Nineteenth Century

Many of the novels written during the course of the nineteenth century have as their theme the chemist or alchemist. Numerous others allude to chemistry. Tracing these novels by means of Library Catalogs is rather difficult and one must depend upon extensive reading to uncover them. A number of the most interesting are given here: (Several short stories are included in the list).

H. Belloc, *Man Who Made Gold.*
F. Olmstead, *Madame Valcour's Lodger.*
Agnes and Egerton Castle, *The Star Dreamer.*
William Godwin, *St. Leon.*
Charles Reade, *The Cloister and The Hearth.*
Sir Frederick Wedmore, *A Chemist in the Suburbs.*
P. Ross, *A Professor of Alchemy.*
Fitz-James O'Brien, *The Diamond Lens.*
Sir Walter Scott, *The Antiquary.*
G. P. Lathrop, *An Echo of Passion.*
Mary Wollstonecraft Shelley, *Frankenstein.*

Zakarias Topelius, *Times of Alchemy.*
William Wilkie Collins, *Armadale.*
Edgar Allan Poe, *Von Kempelen and His Discovery.*
J. K. Huysmans, *Against the Grain.*
Anatole France, *The Queen Pedauque.*
Mirza Fath-Ali and Mirza Ja'Afar, *The Alchemist: A Persian Comedy of the Present Day.* Reprinted in Vol. III of *The Drama: Its History, Literature and Influence on Civilization,* Alfred Bates, Editor-in-chief, London (1903). (This Persian comedy was published at Tehran in 1874 by Mirza Ja'Afar. It is really a translation from a Turkish original, written by Mirza Fath-Ali in 1861).

Erasmus Darwin (1731–1802) noted as a naturalist and poet in addition to being one of the greatest English physicians of his day made frequent and copious allusions to chemistry in his poems of book length, *The Temple of Nature* and *The Botanic Garden.* Darwin's works were widely read and distributed and helped to popularize chemistry at a very early date.

Honoré de Balzac has written several novels with an alchemical background. Among these may be mentioned *The Greatness and Decline of Cesar Birotteau,* and *The Quest of the Absolute.* The latter is a powerful and realistic story concerning Balthazar Claes, a wealthy chemist, who sacrifices everything to the good of science.

Ralph Waldo Emerson is another famous author who frequently mentions chemistry in his writings.

Charles Dickens likewise makes frequent allusions to chemistry in his novels. There are references, among others, to alchemy, india rubber, Prussian blue and spontaneous combustion.

In Dickens's celebrated trial of Bardwell versus Pickwick, the chemist asked the court to be excused from jury duty on the ground that the boy who was left to tend the shop had the impression that "Epsom salts means oxalic acid and syrup of senna, laudanum."

Beginning in 1892 the *Adventures of Sherlock Holmes* by Sir. A. Conan Doyle contain frequent allusions to chemistry and the first adventure in which Dr. Watson meets Mr. Sherlock Holmes, opens in a chemical laboratory.

Development of the Modern Scientific Novel

Jules Verne is generally acknowledged to be the father of the scientific novel due to both the quality and volume of his literary output. Several other writers produced a few scientific novels but they did not exert any great literary effect. Among the more important may be mentioned:

Richard Adams Locke, *The Moon Hoax.*
Edward Bulwer-Lytton, *The Coming Race.*
Cyrano de Bergerac, *A Voyage to the Moon.*
Robert Paltock, *Peter Wilkins and the Flying Indians.*

The novels of Jules Verne cover practically every branch of science known in his day including, of course, chemistry. *The Mysterious Island,* for example, is packed with chemical information. It vividly describes the attempts of a group of castaways on a desert island to produce chemical products vitally necessary to their life and security.

Since the days of Jules Verne the scientific novel has become exceedingly popular and has kept pace with the advance of science. Eventually most of the new discoveries are mirrored in a literary production, not always accurately perhaps, but usually interestingly enough to hold the attention of an enormous number of readers.

The modern scientific novel frequently oversteps the bounds of all probability and there has arisen as a consequence a school of ultra-scientific writers who indulge in the scientific fantasy. The field has become so vast that only a few of the more prominent authors are mentioned in the following list:

H. G. Wells, *The Time Machine.*
Karel Capek, *Krakatit.*
Camille Flammarion, *Urania.*
R. C. Sherriff, *The Hopkins Manuscript.*
Arthur Machen, *The Three Impostors.*
Upton Sinclair, *The Millennium.*

Chemical Novels of the Twentieth Century

Since the turn of the century the output of novels dealing with all phases of science has been enormous. It is possible only to list a few of the many that treat exclusively of chemistry or alchemy:

Lord Dunsany, *The Charwoman's Shadow.*
Sinclair Lewis, *Arrowsmith.*
Thomas Mann, *The Magic Mountain* (Physiological chemistry).
J. B. Priestly, *Far Away.*
G. K. Chesterton, *The Crime of the Communist* (Short story).
H. G. Wells, *Tono Bungay.*
Roger Burlingame, *The Heir.*

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SCIENCE AND NATIONAL DEFENSE

VEVA MCATEE
Director of Science, The George Rogers Clark School, Hammond, Ind.

There are those who blamed science for the machine age and the vast numbers of unemployed. There will be those who will blame science for the present war. But we know that there were wars long before the age of science. Then men fought with clubs and stones. It is true that modern scientific inventions in the hands of unscrupulous war mongers have made it possible to destroy on a large scale; and yet, even in war, science saves more than it destroys. We must not forget that it is science that will be called to the front to provide the means of defense, to heal the sick and the wounded, to contribute to world reconstruction, to abolish fears, superstitions, prejudices, cheap politics, and to disseminate knowledge and truth.

We have all been more or less appreciative in one way or another of the vast possibilities of the instruments of science, but have we as teachers of science been sufficiently aware of the importance of science teaching? It very often takes an emergency to bring us to grips with realities.

What can we as teachers of science do to prove that science teaching in our schools has its place in National Defense? The following is a brief outline of some of the important phases of science teaching which would contribute materially both directly and indirectly to prepare the students in our classes to do their part in meeting this national emergency.

I. Importance of health to National Defense
   1. Cost in lives, time, and money through the flu epidemic of the last world war.
   2. Food and its relation to health.
   3. Fear, hate, anxiety, and its relation to health.
   4. Advancements in favor of health made during and since the last world war.

II. Importance of Conservation
   1. Sources of our common commodities.
   2. Possibilities of new products from old.
   3. Possible substitutions for present materials.
   4. The role of science in supply and demand.
   5. How to increase useful plants and animals and hold in check the harmful.

III. Importance of knowing something of the interdependence of living things.
   1. In the plant and animal kingdom.
   2. Among individuals and organizations in a community.
   3. Among the peoples of the world.
   4. Symbiosis vs. parasitism.

IV. Importance of knowing how man upsets the balance of nature and the price he must pay as a result.
   1. Erosion (flood and dust storms).
   2. Destructive insects and pathogenic organisms.
   3. Destruction of wild life.
   4. Wars
   5. Overgrazing and overproduction.

V. Importance of safety in the home and community.
   1. Knowledge and first aid.
   2. Safety hazards.
   3. Notifying proper authority in time of emergencies.
   4. Making drinking water safe in case of pollution in time of emergency.
   5. Principle of fire extinguishers and methods of putting out fires.

VI. Importance of economy.
   1. Knowing how to repair leaky faucets, drains, electrical appliances, etc.
   2. How to get the most value from fuel and lights.
   3. Proper care of clothing (removal of stains, importance of intelligent laundrying and dry cleaning).
   4. Proper preparation of foods (saving vitamin content).
      a. Nourishment vs. non-essentials such as soft drinks, chewing gum and tobacco.
   5. Ability to read own gas, water, and electric meters.
   6. Ability to judge values of products on the market.
   7. Value of home gardens.

VII. Importance of the role of science in the contributions it has made to our health, comforts, and conveniences.
   1. What would the world be like today if there had been no scientific achievements since 1900? What if the men of science would go on a strike?
   2. New developments as a result of the present war.

VIII. Importance of the scientific method.
   1. In developing proper study habits through knowing the scientific method of problem solving.
   2. In recognizing harmful propaganda; in considering present and post war problems of economy, social adjustments, and world wide relationships.

HIGH SCHOOL GEOGRAPHY IN ILLINOIS*

ALDEN CUTSHALL
Department of Geology and Geography, University of Illinois, Urbana

Geography is no longer a group of uncorrelated facts concerning the earth's surface and the people living upon it. It is a cultural subject with practical applications and is deserving of a more significant role in American secondary education. Its practical value should appeal to the progressive educator for without a knowledge of geography it is hardly possible to read intelligently the daily newspaper. We are a travel-minded nation. Yet travel becomes much more enjoyable if we can read a topographic map and observe and analyze the physical features and human geography of the area traversed.

The University School of Education Placement Bureau reports that in many cases high school geography has been absorbed by general science and schools which have individual geography courses usually have them associated with another physical science or with the commercial subjects. A call for a combination which includes geography is received by this office only two or three times per season.

However, these statements are not substantiated by checking the Illinois School Directory, as there are 103 schools offering only commercial or economic geography, whereas 11 offer only a course in physical geography. This may result from the fact that geography is more often included in a subject combination with social science, mathematics, or the commercial subjects than one that included the physical sciences. A semester of commercial or economic geography is frequently offered along with a semester or business law or business English by the commercial teacher or with commercial arithmetic by the mathematics instructor, or with civics in the department of social studies. Twenty-three schools, many of them having a small enrollment, offer a semester each of physical and commercial geography. Forty-three high schools offer work in geography but it is called World Geography, High School Geography, or some title that cannot be catalogued as definitely physical or economic in character. In the Chicago high schools the work is almost entirely commercial geography.

Dr. Alfred H. Meyer of Valparaiso University, speaking at

* This paper was presented to the Geography Section of the Illinois High School Conference, Nov. 8, 1941. Unless otherwise specified, the facts included in this paper refer to Illinois outside of Chicago.

the Baton Rouge meeting of the National Council of Geography Teachers (1940), stated that about 30% of the junior and senior high schools of our country offer geography. However, because the subject is usually offered as an elective, the percentage of high school pupils receiving training in the subject is considerably less than this figure. Illinois ranks slightly below this average, 27.4% of the accredited four year high schools in this state offering geography. But our position appears somewhat lower if we consider that some of our sister states (Indiana, Ohio, Minnesota, Oklahoma, and Texas) offer geography in more than 70% of the high schools and others (Arkansas, Missouri, Oregon, and Tennessee) in approximately one-half the high schools.

A course in geography is credited to 212 of the 773 four year high schools listed in the Illinois School Directory. This total includes 180 of the 728 schools (24.7%) outside of Chicago, 30 of the 38 Chicago high schools, and two of the eight Chicago evening schools.

TABLE I. GEOGRAPHY IN ILLINOIS HIGH SCHOOLS
(Outside Chicago)

Number of teachers per school	No. schools offering geography	No. schools with one or more full-time geography positions	Enrollment of school	No. schools offering geography	No. schools with one or more full-time geography positions
3– 9	86	0	31– 99	36	0
10–19	43	1	100– 199	47	0
20–29	13	2	200– 299	28	2
30–39	14	4	300– 399	11	1
40–49	4	0	400– 499	9	1
50–59	6	3	500– 599	6	0
60–99	11	8	600– 799	9	1
100 plus	3	1	800– 999	4	1
	—	—	1000–1499	15	6
Total	180	19	1500–1999	8	4
			2000 plus	7	3
			Total	180	19

Since, in most cases, geography is an elective subject, it is only in the larger schools that the geography teacher or teachers have a full schedule of this subject. There are only 19 high schools outside of Chicago with one or more full-time geography teachers. Of the 217 geography teachers in downstate Illinois in 1940–41, 182 also taught one or more other subjects, whereas

in Chicago 61 of the 75 geography teachers taught only the one subject.

The subject combinations range widely, but geography is associated with the social sciences in 65 combinations, about one-third the cases in which the geography offered is insufficient to occupy the entire time of a teacher. Other fields found in combination are: Mathematics (29), Commercial Subjects (28), Physical Sciences (27), English (11), Health, Physiology, or Hygiene (10), and miscellaneous subjects (12). (Under the miscellaneous classification is included Agriculture, Home Economics, Latin, Music, Art, and Physical Education). Other subjects were often included but an attempt was made to classify the combination on the basis of the principal field included in the combination. (In fairness, it should be mentioned that the courses of some schools were grouped rather than listed individually, that is, Social Science was listed rather than History, Civics, Geography, etc.).

Many of the high school geography courses are offered in the smaller high schools and the teacher has several preparations. For example, there are only 35 geography positions (nine of these at Joliet) in which the teacher offers no other subject; in 42 instances geography is offered in a two subject combination; in 48 cases it is one of three subjects taught by the individual; and 92 teachers offer a course in geography along with three or more other subjects. This last is significant because those teachers frequently have only the minimum preparation in geography, probably having majored in some other subject, yet are unable to better prepare themselves during the school year because of the heavy teaching load.

Of the 180 schools offering geography, 86 of them are small schools, having less than 10 teachers and 43 have 10–19 teachers. On the basis of enrollment: 36 have less than 100 pupils; 47 have from 100–199; and 28 from 200–299 pupils. Hence, almost one-half the geography courses offered (47.8%) are in schools with less than 10 teachers and 73.9% of the courses are in schools having less than 300 pupils (Table I).

From this compilation it appears that geography is offered more frequently in the smaller schools than in those of more-or-less average size. Most of the larger schools offer geography as an elective subject. Comparatively, only a few schools of 350–1000 enrollment list a course in geography. Is this merely a coincidence?

Since 1929–30 high school geography in Illinois has shown a decided increase.[1] Although a few geography courses are being added each year, the number of geography teachers have remained about the same for several years. The additions apparently are counterbalanced by the cases in which the subject is dropped from the curriculum. But, why is geography discontinued? Frequently the shift of subjects accompanies a change in personnel, the new staff member either having no geographic training or for some reason is able to substitute another course that has a greater appeal to him. In the cases that I have known it was never discontinued because of a lack of interest and decreased enrollment. High School students are interested in their natural environment. They are naturally curious. In a geography class they can combine native curiosity with the acquisition of facts, both of which they enjoy. In many schools, geography enrollment has increased and additional sections have been added a year or two after the work was inaugurated. Some of the smaller schools offer certain elective subjects only in alternate years, hence from a survey of the Illinois School Bulletin a subject appears to be discontinued when that may not be the case at all. For example, of the 180 schools (outside of Chicago) offering geography in 1940–41, 33 of them did not offer it (according to the Illinois High School Directory) the preceding year. Hence, 31 of the 178 schools offering a geography course in 1939–40 did not offer it last year. This leads one to believe that many schools are offering geography in alternate years.

To summarize, geography has never attained a place in the curriculum of the high schools of Illinois that is commensurate with the fundamental position of the subject in current world affairs. It should be a required full-year subject in all senior high schools, especially for those students that expect to be good, intelligent, future citizens. It would prove far more valuable than Mathematics, Ancient History, or some of the other subjects that those students are electing to complete their sixteen units. An analysis of the present day status of geography apparently reveals that the majority of the people, school administrators not excluded, know little of what the geographer has to offer. It is a study of the world, not just one state or nation, Geography has been raised from courses dealing with capitals, bounda-

[1] A comparison of the finding of Burnis H. Hostettler ("A Study of the Subject Combinations Taught in the Four Year High Schools of Illinois," Unpublished M. S. Thesis, University of Illinois, 1930) and the Illinois School Directory, 1940–41.

ries, rivers, mountains, and statistics to an inspiring interrelated subject surveying human activities throughout the earth. It is a science stressing areal expression and the correlation of human, economic, and physical phenomena; it offers a distinct point of view. In this era of extreme specialization it is able to provide a much needed link between modern physical and social sciences.

We, as Americans, are seeking a common cultural civilization in a human melting pot. We, as a group, are greatly interested in the conservation movement and the orderly utilization of our physical endowments. We cannot discuss these problems without a knowledge of the environment and resources of the different parts of the world. This knowledge cannot be obtained in a course in General Science or History even though these courses include some geographical facts. Probably the History or Science teacher has had no formal geographic training.

The relationship between aviation and geography is of more than mediocre significance, and high school students are aviation enthusiasts. Geography will aid the student in understanding the common terms of the navigator. It will give him a broader conception of the surface features and earth's divisions. It will introduce him to an interpretation of maps and charts. But of even more importance, it will introduce him to meteorology, a fascinating subject, but only a word to the average high school student.

All in all, we are convinced that the position of Illinois high school geography should and could be improved. Geography definitely has something to contribute to, rather than being an encroachment upon, the other subjects offered.

LABOR SHORTAGES

War industries will need 10 million workers *more* before the end of 1942—and most industries will be ready to make their largest "hires"—skilled and semiskilled—about July 1. Employers are likely to hire anyone they can—without waiting even for young people to complete training courses. The armed forces will expand—though how much is exactly what Hitler would like to know. Civil Service and Maritime Commissions, Civil Aeronautics Authority, and other Federal agencies are calling frantically for all types of workers—from stenographers and messengers to physicists.

The real dynamite, however, lies in the threatening farm labor shortages. With largest farm-production goals in their history, farmers are losing their hired hands by the thousands to the Army or to better-paying war-industry jobs.

Express News Letter

NOTES FROM A MATHEMATICS CLASSROOM

JOSEPH A. NYBERG
Hyde Park High School, Chicago

(*Continued from the May issue*)

18. Types of Equations in Beginning Algebra. Last month I raised the question of how the work on equations should be introduced in the first course in algebra. Far down in the elementary grades a pupil learns to add, subtract, multiply, and divide in that order; hence that order of the operations has persisted in all our thinking. Twenty years ago some teachers began teaching fractions in algebra in the order: multiply, divide, add. When introducing signed numbers only the most venturesome teachers used the order: add, multiply, divide, and then subtract. For solving equations I suggest that we think of the operations in the order: divide, add, and then multiply.

For the first type I suggest equations like

$$5x=50 \qquad -2x=30 \qquad 3x=-28 \qquad .2x=1.8 \qquad \tfrac{1}{2}x=7$$
$$-10=2x \qquad 15=-3x \qquad -1.4=7x \qquad 5=x$$

I include negative as well as positive coefficients since the real work on equations should not begin until after the pupil has learned to use signed numbers. The equations should be as varied as possible so that the pupil will not get the idea that he should divide the larger number by the smaller or the right hand number by the left hand number. Fractional coefficients should also be used to show the generality of the method, and the solutions should not all be integral.

For the second type I suggest equations in which a number is added to each member in order to reduce the second type to an equation of the first type. Such equations are

$$5x-12=23 \qquad 6x+5=29 \qquad 7x-2=-30$$
$$19=4x+3 \qquad 17=7-2x \qquad -10+5x=50$$

After the pupil has worked with a dozen such equations he can apply the same idea to equations like

$$5x=60+2x \qquad -3x=20+x \qquad 6x=-18-3x$$
$$30-x=2x \qquad -10+5x=2x \qquad 12+3x=-5x$$

Experience has taught me that with the second type I should avoid fractional coefficients and keep the arithmetic simple.

According to the records I have kept, three days are usually

spent on the first two types. Nothing is said yet about checking the answer. On the fourth day I introduce transposition. Unless transposition is introduced early, the habit of adding will be strongly fixed in the pupil's mind and he will be slow to adopt the faster method. Among the things that I want the pupil to learn about algebra is that it is a great labor-saving and thought-saving device. I admit that in all our teaching we aim to inculcate certain habits of thinking; but we really organize our thoughts, plan our work, and form habits so as to avoid thinking. A good automobile driver applies the brakes, uses the clutch, and changes speeds without thinking of how the transmission works. The internal mechanism was doubtless once explained to him but he should react without thinking. Transposition is an excellent example of how mankind has developed a general rule to save energy. Hence on the fourth and fifth day we study transposition and drill and drill.

On the sixth day we study checking the solution. Seven or eight days are thus needed to lay the foundation for solving equations. It will be noticed that nothing is said about equations like $x+6=13$ or $x-6=9$. Time can be saved by saying nothing about them, and I have never found a pupil who was unable to solve such equations when he met them.

Some time later equations containing parentheses will be studied. When the indicated multiplications have been performed the pupil will have an equation like the second type. Still later the pupil will meet the third type in which both members are multiplied by some number to eliminate the denominators. Then, *after* the pupil has had some experience with the three types we will discuss the four famous axioms of addition, subtraction, multiplication, and division which some teachers think should have been studied on the first day. The pupil gets a better appreciation of the general laws after he has had some experience with a variety of equations.

19. The Misuse of Formulas. A neighbor called me on the telephone and spoke about as follows: "What's the matter with you teachers? Johnny has to find the interest on $230 at 5% for 3 years, and I told him to multiply 230 by .05 and then multiply that by 3. But Johnny says that the teacher wont let him do it that way and he has to use a formula. What's this formula he's talking about? What's wrong with my way?"

After answering the parent I turned to Thorndike's Psychology of Algebra to see if I had answered correctly. On page 281

I found a statement that I would like to call to the attention of Johnny's teacher. "It degrades algebra to invoke it to do what the pupil can do better without algebra." Thorndike also anticipated the teacher's answer for he continues, "The excuse offered for thus making algebra seem a long dull way to do things will be, of course, that we need to have very simple cases as introduction, so that the algebraic fact or principle may stand out clearly, undisturbed by any other difficulties."

This situation, which we know is both frequent and annoying, can be avoided if the teacher (and textbook) will state the problem in a slightly different form. The exercise could be stated in three parts as:

(a) Find the interest on \$230 at 5% for 3 years in any correct way.

(b) In your best English write the rule that you use to find the interest, or

(b′) This problem involves four numbers, the interest, principal, rate of interest, and time. Write in your best English the relation between these numbers; that is, tell how you find the interest when you know the other numbers.

(c) Using suitable letters to represent the numbers, write your rule in mathematical symbols.

In the above plan, the formula appears at the *end* of the problem, not at the beginning. This plan of having the formula appear as the *conclusion* rather than as a *method* can be used whenever the ninth grade class is dealing with problems which have been solved in previous grades by ordinary arithmetic. Algebra is not degraded if we say "Write as a formula the rule you use to find the cost of 5 pounds of sugar at 7 cents a pound" instead of "Use the formula $c=np$ to find the cost of 5 pounds of sugar at 7 cents a pound."

Later it is advisable to use such directions as:

"Do the arithmetic for the following exercises in any correct way but begin each problem by stating in English or in algebraic symbols the rule that you intend to use."

Whether or not the pupil actually substitutes in the formula is immaterial as long as he shows on his paper the numerical work by which he obtained the answer.

20. The Computational Problems of Trigonometry. After teaching trigonometry a great many times a teacher collects a large number of problems dealing with the solution of triangles. There are problems dealing with the law of sines, the law of

cosines, the law of tangents, the ambiguous case, the half-angle formulas, the radii of the inscribed, circumscribed, and escribed circles, computations with four-place tables and with five-place tables, and a host of other problems. For right triangles some pupils may check by using $a^2=(b+c)(b-c)$ while other pupils may use $c^2=(b+a)(b-a)$. For oblique triangles the Mollweide equations can be written in six ways. Hence the job of finding a pupil's computational errors and of making sure that every logarithm is correct even in the last figure is no small task. I have therefor found it worthwhile to collect copies of the many possible solutions and checks of all the computational problems that I assign so that I can compare any solution with a master copy.

The task that bothered me for a long time was that of filing the master solutions so that they could be found easily. I shall mention my method of filing in the hopes that teachers will find it useful or suggest some other method.

In the data of each problem there is necessarily one line that is the shortest. I write this number in the upper right hand corner of the paper, and then file the solutions numerically regardless of the nature of the problem.

The method is so ridiculously simple that I can only wonder why I was late in thinking of it.

21. A Group Can Find Its Own Median. After a class has learned the meaning of *median* it usually asks after each examination, "What was the median?" The easiest, and a well-known, scheme is to have the teacher ask the pupils with scores above 90 to stand, then the pupils with scores above 89, above 88, and so forth until half the class is standing. On some day when the median has been found in this way I try the following experiment; the scheme will often reveal who are the truly brilliant pupils in the class.

I say to the class, "How can the median be found without my asking the pupils to stand as we just did? You may not elect some one else to take my place and do the calling. You may form a line around the room in any manner." After they have formed in a line, I add, "You may speak to the pupil to the right of you but not to anyone else. I'll give you five minutes in which to arrange yourself in order according to your scores with the highest at this end. The pupil who represents the median can then announce his score."

How do they do it?

RECREATION FOR THE DRAFTEE NATURALIST

DON TIMERMAN
Ft. McClellan, Ala.

[Sergeant Timerman is a typical serious college boy from Cornell University now one of Uncle Sam's fighting men. His article is evidence that our army in this war contains many educated men who are not inclined to spend their free hours whistling at passing girls or guzzling beers to the tune of a juke box. It is a great change from the quiet fields and woods to the rumble and roar of an army camp, from conservation to destructon, but it is necessary for world conservation of democratic ideals, and our young men can take it. Let's do more for these men. Ed.]

Recreation means diversion from one's regular work. Providing recreation and entertainment for men in the army is an important part of the war situation. Much has been done in a general way, but the army contains many men who are specialists in various fields. They can not be satisfied with just entertainment of a social nature; what was formerly their regular work can now be their recreation if conditions permit.

Take the case of a naturalist, for example, whose training has been in one locality. In the army he is usually in a new environment, often moving from one locality to another. At first thought this would seem to be a golden opportunity to become acquainted with the new creatures in each section in which he is stationed. In the limited time at his disposal it is impossible to spend time tracing plants or insects through complicated keys, especially without the necessary instrument for observing characters of classification.

The post libraries contain books of a general nature but cover such broad areas that they are quite ineffective. Often one finds books in the south covering material found in some northern state. This is fine for the edification of those anticipating trips to those places but is obviously no help to one wishing to acquaint himself with the south. Local public libraries are of little assistance except that they furnish books and magazines of the more entertaining type. Various nature magazines although available furnish little to satisfy ones curiosity about his immediate environment.

There are the natives of the community whom we may ask but each person may have an entirely different name for the same plant or animal and to many, all evergreens are "pines," all insects are "bugs" and all small fish are "minnies." The inadequacy of this is evident.

How then can recreation be provided for the naturalist? First let us consider the various nature clubs and associations and their part in this vast program of National Defense. The recreational directors would be glad to have speakers come to the recreation halls and present programs for those interested. To be sure there are many bird lovers who would profit by an Audubon bird hike on Saturday afternoons or Sundays. Forestry associations could contribute by making available mimeograph lists of indigenous plants with key characters which would help in identification. Similarly other societies could contribute.

Local school and city museums and park associations afford another channel which could aid those interested in their environment by displays and exhibits of plants and animals of the community. We would be only too willing to obtain material for these exhibits. Those things of little or no interest to a native might be extremely fascinating to others of another locality.

Another source of valuable information is the state universities which have their departments with authorities on the flora and fauna of the region. They could give illustrated talks on their specialty using lantern slides, moving pictures and living or preserved specimens. Through their aid, nature trails could be established within easy access of the various training camps. These would not need to be elaborate.

In connection with the state universities each has bulletins which have been prepared by authorities in the various fields which contain valuable information for a naturalist. Lists of available pamphlets and bulletins which could be obtained at a small price would be a great help and reliable sources of information.

The big question to be raised immediately is, who would be interested in having such facilities made available to them and would it be worth while. As small a percentage as one per cent in a large camp would, it seems, make such efforts well worth while.

In this vast program of defense and preparedness each individual and organization can do their bit not so much by direct aid as by providing recreational facilities for those who are less inclined to frivolous and pointless activities during their off-duty hours.

When you change address be sure to notify Business Manager W. F. Roecker, 3319 N. 14th Street, Milwaukee, Wis.

ALGEBRA AND PHYSICS

PVT. A. GREENFIELD
Signal Corps, Co. D, 5th Battalion, Fort Monmouth, N. J.

It has always been disconcerting to find that the linear equation which the average student passing elementary algebra can master with no great difficulty proves such a stumbling block to physics students, some of whom have had intermediate algebra. No less disconcerting to teachers of mathematics and physics alike are the ridiculous, impossible numerical answers often given to practical problems. Part of every physics teacher's daily unpleasantness is receiving a solution such as that to a lever problem in which the short arm turns out to be 10 times as large as the long arm, or in which the obviously larger force turns out to be one-tenth of the smaller. I say obviously because in most cases, the student will recognize the impossibility of his result as soon as his attention is directed to the physical picture.

In a majority of cases such errors are algebraic or arithmetic rather than scientific; the student divides instead of multiplying, or the decimal point ends up in the wrong place. The teacher usually suppresses his feelings and tries to reteach the algebra. Even if the instructor has had experience in teaching mathematics, re-teaching at this point is not too effective for several reasons. There is no time for the finely graded practice needed in algebra. Often the verbal explanation of the algebraic processes is different from that the students' teachers of mathematics used, resulting in further confusion.

Instead of such reteaching, I would suggest a complete reliance on the physical picture and an attempt by the instructor to get the student into the *habit* of checking the reasonableness of his answer. Such a habit can be started if the teacher follows a solution to a numerical problem with the question:—Is this answer possible? or, Is this reasonable? A correct answer to such a question requires a true understanding of the physical principles involved. Answering it gives much needed practice in application of the principles as well as in developing a highly desirable habit. On examinations provisions should be made for such a question following numerical problems. A correct statement that an answer is impossible should be rewarded with some credit. (On short answer tests, it may be necessary to ask for reasons to prevent their putting down any answer and saying

it is impossible. But an explanation requires enough thinking to deserve credit.) It may even be advisable to "pick answers out of a hat" and give practice in testing their possibility.

It will be found that different students will react to this procedure in different ways. The mathematically minded will tend to check by substituting the answer in the original equation as is ordinarily done in algebra. Where the answer is awkward or fractional, these pupils should be encouraged to use the nearest simple integer so that the process of checking be not as involved or as time consuming as the original solution. The habit of checking by the nearest multiple of 10 is, I believe, a desirable one.

In a physics class will be found many students who are visual and mechanical minded. These are the ones who embark with a prayer in their hearts, on the handling of abstract symbols according to certain rules. They are benefited most by emphasis on the physical picture. Furthermore some of these will tend to estimate the answer even before they attempt an exact algebraic solution. Since the numbers used are usually very simple it is often possible to guess the exact answer in this manner. I feel that obtaining the answer in this way gives as much if not more practice in the application of physical principles; and the latter is the primary objective of numerical problems.

Hence I propose that some attempt be made to encourage such estimating in lieu of algebraic solutions, for those who show weakness in the latter. Because algebraic techniques must be exact and admit of no partial or approximating results, the average high school physics student finds them difficult to cope with in the years after he has left school. Facility in estimating a result based on a principle of physics will probably remain as long as the principle remains, which is a good deal longer than abstract manipulations will remain. The skilled worker in industry will rely more on such an approach to his problems because of an additional reason; exact results are usually unnecessary since one never works with weightless levers, or frictionless bearings, etc.

Several objections to the above suggestions come to mind immediately. Are we to discourage precise working and thinking? Did not science really begin to achieve only since it became quantitative? Is this an indictment of the teaching of algebra?

The only answer I can offer is that the small proportion of our students who are going to become engineers will probably find little difficulty with the algebra in the first place. As educa-

tors in a democracy we must try to give our future skilled worker a mathematical tool he is more likely to use.

In the last dozen years most of the mathematics formerly taught in physics has been removed. This has been done partly because of its difficulty to present day students. Yet the algebraic work formerly required in physics was on a level far lower than that taught today in intermediate algebra. Furthermore, there are more classes in intermediate algebra in our high schools today than there are physics classes. I wonder if it would be possible to include somewhere in the mathematics syllabi a number of problems formerly taught in physics. Having taught under a mathematics license I am aware of the crowded state of these courses of study. But with the present emphasis on functionality, developing some of the laws of physics experimentally in the mathematics classroom would unquestionably act as motivation as well as help provide a real meaning to the concept of functionality. The demonstration should, of course, be given at a time when the type of equation resulting from application of the law illustrated is the type being studied. Hence what would in physics be the most difficult and trying part of the lesson now becomes a short step in the finely graded process of learning algebra.

The experimental approach to formulas has been tried in many algebra classes. The laws governing the spring balance, the mercurial thermometer, friction, etc. have been developed and the formulas set up from sets of numbers obtained experimentally. Reports from teachers who have tried such presentations indicate that further experimentation in this field should prove fruitful and mutually beneficial to both algebra and physics.

LIBRARY WAR CODE

Every library must, says the Council of the American Library Association:

1. Become a war information center.
2. Supply technical information to industrial defense workers and students.
3. Disseminate authentic information and sound teachings in the fields of economics, government, history and international relations.
4. Make available valid interpretations of current facts and events.
5. Help to relieve the strain of war by maintaining its supply of recreational reading for men and women, and especially for children.
6. Help and support postwar planning.

A CALENDAR OF THE BIRTHDAYS OF SCIENTISTS FOR AUGUST AND SEPTEMBER[1]

JAMES D. TELLER
College of Education, Ohio State University

Day	*Year*	*Name*	*Birthplace*	*Specialty*
AUGUST				
1	1817	Sir Joseph Henry Gilbert	Hull, England	Chemist
1	1744	*Jean Baptiste Lamarck	Bazantin, Picardy, France	Naturalist
1	1818	Maria Mitchell	Nantucket, Massachusetts	Astronomer
1	1779	*Lorenz Oken	Bohlsbach, Baden, Germany	Naturalist
1	1808	Henry Darwin Rogers	Philadelphia, Pennsylvania	Geologist
2	1820	*John Tyndall	Co. Carlow, Ireland	Natural philosopher
3	1851	*George Francis Fitzgerald	Dublin, Ireland	Physicist
4	1755	Nicholas Jacques Conte	Aunou-Sur-Orne, France	Chemist
4	1852	Sir James Johnstone Dobbie	Glasgow, Scotland	Chemist
4	1841	William Henry Hudson	Quilmes, Argentina	Naturalist
5	1834	Ewald Hering	Alt-Gersdorf, Saxony	Physiologist
6	1940	Adolph Francis Alphonse Bandalier	Bern, Switzerland	Archaeologist
7	1874	Louis Agassiz Fuertes	Ithaca, New York	Naturalist
7	1783	John Heathcoat	Duffield, England	Inventor
8	1863	Florence Merriam Bailey	Locust Grove, New York	Ornithologist
8	1861	William Bateson	Whitby, England	Biologist
8	1857	*Henry Fairfield Osborn	Fairfield, Connecticut	Palaeontologist
8	1779	Benjamin Silliman	Trumbull, Connecticut	Chemist
8	1882	Henry Spahlinger	Geneva, Switzerland	Bacteriologist
10	1861	Sir Almroth Edward Wright	Middleton Tyas, Yorks	Bacteriologist
11	1799	Joachim Barrande	Haute Loire, Austria	Palaeontologist
11	1854	Felix von Luschan	Vienna, Austria	Anthropologist
11	1814	Jeffries Wyman	Chelmsford, Massachusetts	Biologist
12	1807	George Busk	Leningrad, Russia	Zoologist
13	1814	*Anders Jonas Ångström	Lögdö, Medelpad, Sweden	Physicist
13	1888	John Logie Baird	Helensburgh, Scotland	Inventor
13	1819	Sir George Gabriel Stokes	Ireland	Physicist
14	1871	Paul Bartsch	Tuntschendorf, Germany	Biologist
14	1792	John Jeremiah Bigsby	Nottingham, England	Geologist
14	1859	James Furman Kemp	New York, New York	Geologist
15	1794	Elias Magnus Fries	Femsjö, Smaland	Botanist
15	1842	Sir William Augustus Tilden	St. Pancreas, London	Chemist
15	1796	John Torry	New York, New York	Botanist
16	1845	Gabriel Lippman	Hollerich, Luxembourg	Physicist
16	1832	*Wilhelm Max Wundt	Neckaran, Baden, Germany	Physiologist
17	1699	Bernard de Jussieu	Lyons, France	Botanist
19	1646	John Flamsteed	Derby, England	Astronomer
19	1867	Willis Linn Jepson	Vocaville, California	Botanist
19	1830	*Julius Lothar Meyer	Varel, Oldenburg, Germany	Chemist
19	1808	James Nasmyth	Edinburgh, Scotland	Engineer-inventor
19	1871	*Orville Wright	Dayton, Ohio	Inventor
20	1818	John Ball	Dublin, Ireland	Naturalist
20?	1779	*Jöns Jakob Berzilius	Linköping, Sweden	Chemist
20	1792	Jacques Ignace Hittorff	Cologne, France	Archaeologist
21	1816	Charles Frédéric Gerhardt	Strasbourg, France	Chemist
22	1862	William Harvey Brown	Des Moines, Iowa	Zoologist
22	1857	Giacomo Luigi Ciamician	Trieste, Italy	Chemist
22	1834	*Samuel Pierpont Langley	Roxbury, Massachusetts	Physicist
22	1647	*Denis Papin	Blais, France	Physicist
23	1769	*Georges Léopold Cuvier	Montbelaird, France	Naturalist
23	1839	*James Geike	Edinburgh, Scotland	Geologist

Day	Year	Name	Birthplace	Specialty
24	1821	Amédée Ernest Manchez	Madrid, Spain	Astronomer
26	1873	*Lee de Forest	Council Bluffs, Iowa	Inventor
26	1728	Johann Heimrich Lambert	Mulhouse, Alsace, Germany	Physicist
26	1743	*Antoine Laurent Lavoisier	Paris, France	Chemist
26	1833	Stephen Joseph Perry	London, England	Astronomer
27	1829	Gustaf Linstrom	Wisby, Gotland, Sweden	Palaeontologist
27	1850	Augusto Righi	Bologna, Italy	Physicist
28	1858	Roland Thaxter	Newton, Massachusetts	Botanist
29	1834	Hermann Johann Philip Sprengel	Schillerslage, Germany	Chemist
30	1871	*Ernest Rutherford Rutherford	Nelson, New Zealand	Physicist
30	1852	Jacobus Henricus Van't Hoff	Rotterdam, Holland	Chemist
31	1663	Guillaume Amontons	Paris, France	Physicist
31	1815	Heinrich Ernest von Beyrich	Berlin, Germany	Geologist
31	1786	Michel Eugene Chevreul	Angers, France	Chemist
31	1809	Oswald Heer	Nieder-Utzwyl, Switzerland	Naturalist
31	1821	*Hermann Ludwig Ferdinand von Helmholtz	Potsdam, Germany	Physiological physicist
SEPTEMBER				
1	1877	Francis William Aston	Harborne, Birmingham, England	Physicist-chemist
1	1872	Benjamin Minge Duggar	Gallion, Alabama	Botanist
1	1854	Anna Botsford Comstock	Otto, New York	Naturalist
1	1862	Rado de Kavesligethy	Verona, Italy	Astronomer
2	1814	Ernest Curtius	Lübeck, Germany	Archaeologist
2	1860	Frank Hall Knowlton	Brandon, Vermont	Palaeobotanist
2	1853	*Wilhelm Ostwald	Riga, Germany	Chemist
2	1877	*Frederick Soddy	Eastbourne, Sussex	Scientist
3	1704	Joseph de Jussieu	Lyons, France	Botanist
5	1787	Francois Sulpice Bendant	Paris, France	Mineralogist
5	1826	Thomas Sterry Hunt	Norwich, Connecticut	Geologist
6	1766	*John Dalton	Eaglesfield, Cumberland, England	Chemist
6	1828	David Forbes	Isle of Man, British Isles	Chemist
6	1876	John James Rickard MacLeod	Dunkeld, Scotland	Physiologist
6	1802	Aleide Dessalines D'Orbiguy	Canërzon, Laire, Inférieure, France	Palaeontologist
7	1829	Ferdinand Vandeveer Hayden	Westfield, Massachusetts	Geologist
7	1829	*Friedrich August Kekule	Darmstadt, Germany	Chemist
8	1848	Victor Meyer	Berlin, Germany	Chemist
9	1842	Elliott Canes	Portsmouth, New Hampshire	Naturalist
9	1737	*Luigi Galvani	Bologna, Italy	Physiologist
9	1794	William Lansdale	Bath, England	Geologist
9	1823	Joseph Leidy	Philadelphia, Pennsylvania	Palaeontologist
9	1843	Oskar Mantelius	Stockholm, Sweden	Archaeologist
10	1892	*Arthur Holly Compton	Wooster, Ohio	Physicist
10	1857	James Edward Keeler	Lasalle, Kansas	Astronomer
11	1877	*Sir James Hopwood Jeans	London, England	Philosopher of Science
11	1798	Franz Ernest Neumann	Jaachimstad, Germany	Mineralogist
12	1818	*Richard Jordan Gatling	Hartford County, North Carolina	Inventor
12	1811	James Hall	Hingham, Massachusetts	Geologist
12	1812	*Richard March Hoe	New York, New York	Inventor
12	1699	John Martyn	London, England	Botanist
12	1851	Sir Arthur Schuster	Frankfurt-on-Main, Germany	Physicist
13	1820	Christoph Gottfried Andraes Giebel	Saxony, Germany	Zoologist
13	1851	*Walter Reed	Glouster County, Virginia	Bacteriologist
13	1829	Charles Wachsmuth	Hanover, Germany	Palaeontologist
14	1847	William Edward Clyrton	London, England	Physicist
14	1769	*Alexander Humboldt	Berlin, Germany	Naturalist
14	1849	*Ivan Petrovich Pavlov	Ryazan, Russia	Physiologist

Day	Year	Name	Birthplace	Specialty
15	1736	Jean Sylvain Bailey	Paris, France	Astronomer
15	1839	George Lunge	Breslau, Germany	Chemist
15	1832	Sir Andrew Noble	Greenock, Scotland	Physicist
15	1795	James Gates Percival	Berlin, Connecticut	Geologist
16	1874	Frederick Edward Clements	Lincoln, Nebraska	Plant oecologist
16	1876	Ellsworth Huntington	Galesburg, Illinois	Geographer
16	1816	Sir Charles Thomas Newton	Bredwardine, Herefordshire, England	Archaeologist
17	1819	J. Peter Lesley	Philadelphia, Pennsylvania	Geologist
18	1819	*Jean Bernard Léon Foucault	Paris, France	Physicist
19	1749	Jean Baptiste Joseph Delambre	Amiens, France	Astronomer
19	1759	William Kirby	Witnesham, Suffolk, England	Entomologist
20	1842	*Sir James Dewar	Kincardine-on-Forth, Scotland	Chemist-physicist
20	1784	Sir Richard John Griffith	Dublin, Ireland	Geologist
21	1766	Christian Ludwig Ideler	Perleberg, Germany	Astronomer
21	1853	Heike Kamerlingh Onnes	Graningen, Holland	Physicist
22	1791	*Michael Faraday	Newington, Surrey, England	Chemist-physicist
22	1741	Peter Simon Pallas	Berlin, Germany	Naturalist
22	1863	Alexandre Émile John Yersin	Rougemont, Switzerland	Bacteriologist
23	1791	Johann Franz Encke	Hamburg, Germany	Astronomer
23	1819	Armand Hippolyte Louise Fitzeau	Paris, France	Physicist
24	1802	Étienne Jules Archiae	Reims, France	Geologist
25	1843	*Thomas Chrowder Chamberlain	Mattoon, Illinois	Geologist
25	1798	Jean Baptiste Élie de Beaumont	Calvadoo, France	Geologist
25	1866	*Thomas Hunt Morgan	Lexington, Kentucky	Biologist
25	1644	*Ole Roemer	Aarhuus, Jutland	Astronomer
25	1750	*Abraham Gottlab Werner	Upper Lusatia, Saxony	Geologist
26	1784	Christopher Hansteen	Oslo, Norway	Astronomer
27	1824	Benjamin Apthorp Gould	Boston, Massachusetts	Astronomer
27	1818	Adolphe Wilhelm Hermann Kalbe	Elliehausen, Germany	Chemist
27	1842	Alphonse Francois Renard	Renaix, Belgium	Geologist
28	1807	Arnold Henry Guyot	Boudevilliers, Switzerland	Geologist
28	1852	*Henri Moissan	Paris, France	Chemist
29	1803	Gregor von Helmersen	Laugut-Duckershof, Russia	Geologist

[1] All data are taken from *The Encyclopaedia Britannica*, 14th edition. For the uses and limitations of such a calendar, the reader is referred to the article which accompanies the calendar for October in SCHOOL SCIENCE AND MATHEMATICS, vol. XLI, pp. 611–619, October, 1941. Calendars for the following months will be found in *ibid.*, vol. XLI, p. 768, November, 1941; *ibid.*, vol. LXI, pp. 884–885, December, 1941; *ibid.*, vol. XLII, pp. 87–88, January, 1942; *ibid.*, vol. XLII, pp. 187–188, February, 1942; *ibid.*, vol. XLII, pp. 207–208, March, 1942; *ibid.*, vol. XLII, pp. 312–314, April, 1942 (contains calendars for April and May); *ibid.*, vol. XLII, pp. 490–492. May, 1942 (contains calendars for June and July).

* The starred names have been used by the writer in various bulletin board projects during the past twelve years.

WEIGHTS AND MEASURES

The National Bureau of Standards has prepared three circular letters that answer many questions that often come up in science classes. Copies of these letters may be obtained on request to the National Bureau of Standards, U. S. Department of Commerce, Washington, D. C. The letters are:

Letter Circular LC 449. Standards of Length, Mass, and Time, 8 pages. Sept. 19, 1935.

Letter Circular LC 681. Units and Systems of Weights and Measures, 12 pages. March 25, 1942.

Letter Circular LC 682, General Tables of Weights and Measures, 15 pages. March 25, 1942.

ACADEMIC PRE-TRAINING FOR AVIATION CADETS

In January the War Department appointed a committee of noted mathematicians "to make a survey of the ground school courses in the Air Corps Flying Training System, with a view to outlining preparatory courses to be offered in colleges and universities." After thorough investigations at various schools of the Air Corps the committee submitted its report to the Chief of the Air Corps. In March Major General Yount issued the following letter:

WAR DEPARTMENT
HEADQUARTERS AIR CORPS FLYING TRAINING COMMAND
WASHINGTON

1. In order to man our ever increasing armada of combat planes, the Air Corps has need for a continuous flow of well prepared, intelligent aviation cadets. It is definitely our opinion that the typical young man who satisfies the recently announced requirements for enlistment as an aviation cadet will satisfactorily pass one of the curricula of the Air Corps for which he is eligible. However, certain subject matter which can be studied in high school or in college would widen the possible range of a cadet's usefulness to the Air Corps and might decrease the time required for him to arrive at maximum combat efficiency. Consequently, in the case of a young man who does not intend to enlist immediately as an aviation cadet, but who plans such action later, the Air Corps recommends whichever of the following arrangements for pre-training is most appropriate for him:

Plan I. Pre-training Through Regular High School and College Courses

If time limitations permit, it is recommended that a student get his pre-training through regular high school and college courses, including the following: advanced high school algebra; at least twenty-five lessons in solid geometry including the geometry of the sphere; plane and spherical trigonometry; descriptive astronomy; a college course in general physics; a course including a substantial amount of cartography. Additional courses in mathematics and the physical sciences would be useful for particular objectives within the Air Corps. It should be noticed that many of the courses in the preceding program can be taken in high school.

Plan II. A Special College Curriculum

Prerequisites: Elementary high school algebra and plane geometry, as taken normally in grades 9 and 10.

Extent: Fifteen semester-units or the equivalent in college quarter-units, divided between three courses. This amounts to approximately 260 class hours of recitations, lectures, and examinations; *two* hours of laboratory work are to be rated as the equivalent of *one* hour of recitation or lecture.

Time Allowance: One semester, or at most two quarters.

Course A: Mathematics; 6 Semester Units

General Features: The emphasis on theory should be limited to that minimum amount which is essential if the student is to appreciate the con-

tent of the course. Numerical applications should be emphasized whenever possible.

Part 1. Algebra: Approximately 25 class hours; the content should be selected from any reputable college text to emphasize the manipulative skills needed for numerical trigonometry, physics, and the most elementary technical fields; graphical methods should be introduced.

Part 2. Plane Trigonometry and Logarithms: Approximately 40 class hours; the content should be selected from any reputable college text including both plane and spherical trigonometry; primarily a course in the numerical aspects of trigonometry with only that amount of analytical trigonometry which is essential for the major purpose of the course and for the similar course in spherical trigonometry; substantial emphasis on slide rule computation with each student possessing a cheap slide rule; stress on applications of all sorts, particularly those involving vector forces and velocities and army or navy terminology; only simple aspects of graphing need be included.

Part 3. Solid Geometry: Approximately 25 class hours; the course is designed to create accurate space intuitions on the part of the student and to prepare him for spherical trigonometry and certain aspects of astronomy; the content should be selected from any standard text for high school solid geometry and should include a treatment of straight lines, planes, dihedral and trihedral angles, and the geometry of the sphere; other major parts of the usual course may be practically omitted; proofs should be held to a bare minimum; great emphasis should be placed on the drawing of figures and the making of simple paper models for three dimensional situations; the items of content which will be used in spherical trigonometry should receive particular attention.

Part 4. Spherical Trigonometry: Approximately 10 hours; introduction to the formulas for the solution of right triangles and general triangles; emphasis on problems relating to latitude, longitude, and the astronomical triangle on the celestial sphere; examinations should be of the "open book" type; a major object of the course is to give the student confidence later in the use of navigation tables which frequently make it unnecessary for the navigator to carry out the solution of spherical triangles.

Course B: Astronomy, Maps, and Weather: 4 Semester Units

General Characteristics: The object of this course is to give a thorough familiarity with those features of astronomy which are essentials for navigation. It would be sufficient to give merely a few lectures of popular type concerning the topics stressed in the usual course in descriptive astronomy, but not included below. The textbooks on descriptive astronomy, now available for this course will have to be supplemented by material on map projections and weather phenomena.

Topical Outline: Coordinates on the celestial sphere; motions of the earth; rough determination of time; star charts and maps; the atmosphere; seasons and climates; the planets; identification of stars and planets in evening laboratory hours, not necessarily using a telescope.

Course C: Physics: 5 Semester Units

General Features: Numerical problems, vector methods, and applications of trigonometry should be stressed at every opportunity. The course should not be of theoretical type. It should include from two to four hours of laboratory work per week. The teacher should employ a standard college textbook from which most of the indicated topics can be selected.

Topical outline: Mechanics; heat; light; sound; electricity and magnetism. At the appropriate places, the following topics should be given spe-

cial attention because of their importance in meteorology: saturation; vapor pressure; humidity; latent heat of condensation; evaporation; sublimation; fusion; super-saturation; super-cooling.

Note: The preceding special Plan II could be telescoped into eleven or twelve weeks for students who have already had advanced high school, algebra and some solid geometry.

BARTON K. YOUNT
Major General, U. S. Army
Commanding

Professor W. L. Hart, Department of Mathematics, University of Minnesota, comments on this letter as follows:

"There are clear implications with respect to secondary as well as college curricula in the Air Corps recommendations for pre-training. It is obvious that the paramount importance of air warfare, and the mammoth proposed development of our air forces, makes this pre-training program one of the most essential present responsibilities of the field of education in the United States. If there were justified hopes that the war is to be short, there would be reason for championing hurry-up special courses to provide boys of the 11th and 12th grades with a smattering of the pre-training. However, such an optimistic viewpoint is untenable. Hence, it is clear that the pre-training program may be considered as asking for only *substantial regular courses in mathematics and physics* at the secondary level for intelligent boys with good physiques. An exception to the *regularity* just mentioned may occur profitably in presenting solid geometry and spherical trigonometry. It would be defensible to offer them in a single combined semester course based on a prerequisite of advanced algebra and plane trigonometry. It might be desirable for departments of mathematics and physics to cooperate in the high schools in order to give interested boys an opportunity to take a reasonably mathematical course in physics."

YOUTH LOOKS AT TEACHING

"Youth, reviewing the requirements and rewards of teaching, mentally compares education with other occupations. It is becoming more and more self-evident to young people that in comparison to other occupations teachers are poorly paid, and potential teachers are directing their talents elsewhere. Whether the comparison be made by a boy who views the average weekly wage in Wisconsin manufacturing industries ($33.80 \times 52 = $1,757.60) or the girl who realizes that a short stenographic course will permit her to start at a salary comparable to what the average woman teacher with nearly four years of college and nearly ten years of experience receives, or prospective rural teachers who see the charwomen in state service being paid more than training and experience in rural teaching would command, the effect is the same. It adds up to the selection of another occupation and results in an acute shortage of well-qualified teachers."—*Too Little, Too Late*, Wisconsin Education Association.

Children are not born to be delinquent. They become delinquent because of lack of guidance, unhealthy environment and, in many instances, because of economic disadvantages.—JACOB PANKEN.

PROBLEM DEPARTMENT

CONDUCTED BY G. H. JAMISON
State Teachers College, Kirksville, Mo.

This department aims to provide problems of varying degrees of difficulty which will interest anyone engaged in the study of mathematics.

All readers are invited to propose problems and to solve problems here proposed. Drawings to illustrate the problems should be well done in India ink. Problems and solutions will be credited to their authors. Each solution, or proposed problem, sent to the Editor should have the author's name introducing the problem or solution *as on the following pages.*

The editor of the department desires to serve its readers by making it interesting and helpful to them. Address suggestions and problems to G. H. Jamison, State Teachers College, Kirksville, Missouri.

SOLUTIONS AND PROBLEMS

Note. Persons sending in solutions and submitting problems for solutions should observe the following instructions.

1. Drawings in India ink should be on a separate page from the solution.

2. Give the solution to the problem which you propose if you have one and also the source and any known references to it.

3. In general when several solutions are correct, the one submitted in the best form will be used.

LATE SOLUTIONS

1756. *Edgar Rose, Rochester, N. Y.*

SOLUTION OF PROBLEMS

1759. No solution has been offered.

1760. *Proposed by Claude P. Rook, Chillicothe, Ohio.*

The curves $y=x\log x$ and $y=x\log(1-x)$ intersect at the origin and at another point A. Find the angle of intersection at A.

Solution by Morris I. Chernofsky, New York, N. Y.

Solving the two equations simultaneously, A is $(.500,-.347)$.

The slope m_1 of the tangent to

$$y=x\log x$$

at $A(.500,-.347)$ is .307.

Similarly, the slope m_2 of the tangent to

$$y=x\log(1-x)$$

at $A(.500,-.347)$ is -1.693.

Therefore, by the well-known theorem, the angle between these two tangents, and hence the angle of intersection of the curves at A, is

$$\beta=\arctan\frac{m_1-m_2}{1+m_1m_2}=76°30'.$$

Solutions were also offered by Paul C. Overstreet, Wilmore, Ky.; Julius Brandstatter, Los Angeles, Calif., and Arthur Danzl, Collegeville, Minn.

1761. *Proposed by D. F. Wallace, St. Paul, Minn.*

If x, y and z are integers such that

$$x-y=1$$
$$x^2+y^2=z^2$$

show that $2x+y+2z$ and $x+2y+2z$ are consecutive integers, the sum of whose squares is the square of an integer.

Solution by Norman Anning, University of Michigan

The given numbers are consecutive because one is obtained from the other by adding $(y-x)$ which is given equal to one.

The sum of the squares of the two given numbers is $=5x^2+5y^2+8z^2+12yx+12zx+8xy$ and since $x^2+y^2=z^2$, the sum $=4x^2+4y^2+9z^2+12yz+12zx+8xy=(2x+2y+3z).^2$

Solutions were also offered by Paul C. Overstreet, Wilmore, Ky.; Thomas A. Pickett, So. Weymouth, Mass.; David Rappaport, Chicago, Ill.; Malcolm Kirk, West Chester, Pa., and the proposer.

1762. *Proposed by Walter Sackett, Evanston, Ill.*

Solve for x:

$$80^5-100x^3+25x-1=0.$$

Solution by proposer.

$$16x^5-20x^3+5x-\tfrac{1}{2}=0.$$

Since $\cos 5\theta=16\cos^5\theta-20\cos^3\theta+5\cos\theta$, let $x=\cos\theta$ from which $\cos 5\theta=.2=\cos 78°28'$. Hence $5\theta=78°28'+2\pi n$, with $n=0$, 1, 2, 3, 4 and $\theta=15°41.6'$. This gives $x=\cos(\theta+72°)$, $\cos(\theta+144°)$, etc. The five values of x are: .96272, 55465, 04025, $-.93785$. $-.93662$.

A similar solution was also offered by Norman Anning, University of Mich.

1763. *Prospoed by Paul C. Overstreet, Wilmore, Ky.*

On March 11, 1939 I had been married half my life. On November 9, 1941 I shall be just twice as old as my son. I was married on the eighth day of June, and my son was born in 1916. What is the date of my birth?

Solution by Malcolm Kirk, West Chester, Pa.

Since the son was born in 1916, let a be the number of days the son lived in 1916, therefore $a<365$.

On November 9, 1941, son's age $=(a+9078)$ days.

On November 9, 1941, father's age $=2(a+9078)$ days.

On March 11, 1941, father's age $=[2(a+9078)-974]$ days.

On June 8, year to be determined,

$$\text{father's age}=\frac{[2(a+9078)-974]\text{ days}}{2}.$$

The marriage could not have occurred after 1916 and very unlikely in 1916, and not before 1915 since in that case $a>365$, a contradiction of given data. Therefore the year was 1915.

8677 is the number of days between June 8, 1915 and March 11, 1939. This equals half the father's age on March 11, 1939. Therefore the father was born 8677 days before June 8, 1915.

Also the father was born 17354 days before March 11, 1939. Therefore the date of birth is Sept. 5, 1891. June 8 is counted as a day of married life and the married life is counted up to March 11, 1939. If March 11,

1939 be counted as a day of married life then the date of birth is Sept. 4, 1891.

A solution was also offered by the proposer.

1764. *Proposed by Julius Brandstatter, LosAngeles, Calif.*

Show that $\sin x < x$ but $\sin x > x - \frac{1}{2}x^2$.

First Solution by the Proposer

$f(x) = \sin x, f'(x) = \cos x \qquad f''(x) = -\sin x$

$f(0) = 0, f'(0) = 1 \qquad f''(\theta x) = -\sin(\theta x).$

By use of Law of the Mean: $f(x) = f(0) + xf'(\theta x)$, where θ is a positive proper fraction; then

$$\sin x = 0 + x\cos(\theta x) < x, \quad \text{since} \quad \cos(\theta x) < 1 \tag{1}$$

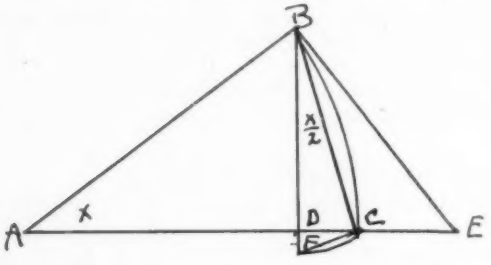
and

$$f(x) = f(0) + xf'(0) + \frac{x^2}{2}f''(\theta x) \tag{2}$$

which is another form of the law of the mean; and by (2)

$$\sin x = 0 + x - \frac{x^2}{2}\sin(\theta x) > x - \frac{x^2}{2} \quad \text{since} \quad |\sin(\theta x)| < 1.$$

Second solution by Malcolm Kirk, West Chester, Pa.



In the figure

$AB = AC = 1, \quad BF = BC,$

$BD = \sin x, \quad BE = \tan x, \quad \text{angle } DBC = \frac{x}{2},$

$DC = 1 - \cos x, \quad \overset{\frown}{BC} = x, \quad \overset{\frown}{FC} = \frac{x}{2}$

$\overset{\frown}{BC} >$ line BC (by definition)

line $BC >$ line BD (opposite the greater angle)

$\therefore \quad BC >$ line BD

or $\quad x > \sin x$

Now, $\quad \tan x > x$ (can be shown by use of the power series) (1)

Hence $\quad \frac{\sin x}{x} > \cos x$, and from figure (2)

$\frac{x}{2} >$ line $FC >$ line $DC = 1 - \cos x$. Transposing, (3)

$$\cos x > 1-\frac{x}{2}. \quad \text{From (2)} \tag{4}$$

$$\frac{\sin x}{x} > 1-\frac{x}{2}, \quad \text{or}$$

$$\sin x > x-\frac{x^2}{2}.$$

Solutions were also offered by Mary Chisholm, New York, N. Y.; Mrs. Walter R. Warne, Rochester, N. Y., and Walter R. Warne, Rochester, N. Y.

STUDENT HONOR ROLL

This editor will be very happy to make special mention of high school classes, clubs, or individual students who offer solutions to problems submitted to this department. Teachers are urged to report to the Editor such solutions.

No solutions were offered for this issue.

PROBLEMS FOR SOLUTION

1777. *Proposed by Isabella Moore, Boston, Mass.*

In triangle LMN, D, E, and F are the mid points of MN, NL and LM respectively. If LP is perpendicular to MN, show that D, P, E, F are concyclic. (P is on MN).

1778. *Proposed by Lucille Rich, Albany, N. Y.*

For equation

$$x^3+px^2+qx+r=0, \quad \text{find} \quad \sum \frac{a^2}{bc}\left(1+\frac{b}{a}\right)^2\left(1+\frac{c}{a}\right)^2,$$

where a, b, c, are roots of the equation.

1779. *Proposed by Parker Brown, Benton Harbor, Mich.*

What fractions with denominators of 7 and 11 are divisible by $2\frac{3}{7}\frac{9}{7}$?

1780. *Proposed by Constance Kurres, Dundee, N. Y.*

Resolve into factors $(a+b+c)(a+b-c)(a+c-b)(b+c-a)(a^2+b^2+c^2)-8a^2b^2c^2$.

1781. *Proposed by Jane Mooney, Dundee, Mich.*

Solve:

$$\sqrt{1+x^2}-\sqrt{1-x^2}=\sqrt{1-x^4}.$$

1782. *Proposed by Howard D. Grossman, New York, N. Y.*

Let

$$S_1=1+\tfrac{1}{3}+\tfrac{1}{5}+\tfrac{1}{7}+\cdots,$$

And

$$S_2=-\tfrac{1}{2}-\tfrac{1}{4}-\tfrac{1}{6}-\tfrac{1}{8}-\cdots,$$

Also S_3 = the series formed by taking in order u terms from S_1, v terms from S_2, then the next u from S_1, etc. Show that S_3 converges to the limit, $\log 2\sqrt{u/v}$.

SCIENCE QUESTIONS

June, 1942

Conducted by Franklin T. Jones,
10109 Wilbur Avenue, SE, Cleveland, Ohio

SCIENCE AND SUMMERTIME OF 1942

We cannot forecast what the summer of 1942 will bring to us, especially in the manufacturing sections of the United States.

The terrifying ROC of Sinbad the Sailor was nothing compared to the "eggs" which may, possibly, be dropped from the skies this summer. We can be sure, however, that what has happened elsewhere may also happen here. It is hoped that the warnings of the past year have been heeded and that the boys and girls in your classes are very much better prepared to meet whatever does happen than less fortunate boys and girls in distant lands.

A FEW PERTINENT QUESTIONS

The following questions are directed to you for you to supply your own answers. Comments and other questions are desired.

963. What are your own answers to the following:

(1)—Do you *know how* to put out—(*a*) A magnesium bomb; (*b*) A thermit bomb; (*c*) An ordinary home fire; (*d*) A grass fire; (*e*) A forest fire; (*f*) An oil fire?

And, what is more important, have you *practiced doing it?*

(2)—Do you *know how* to render First-Aid to a person who has been (*a*) Burned by ordinary fire; (*b*) Burned by gas fire; (*c*) Burned by a live wire; (*d*) Injured in an auto wreck; (*d*) Injured by explosives; (*e*) Drowned; (*f*) Gassed.

(3)—Do you *know how* to keep from becoming a casualty yourself while helping others?

(4)—Do you know how to pry up timbers so as not to injure more seriously the imprisoned person whom you are trying to help?

(5)—In case of emergency do you know enough to use a welding torch to cut light metal away from an imprisoned person without injury to him or yourself?

(6)—In general, do you know what you should try to do yourself and what you should leave for an expert?

(7)—Do you know how and when to give artificial respiration?

(8)—Do you know the mechanics of artificial respiration and have you taught them to your classes? (That means everybody, not just the physics teacher.)

(9)—Did you know that in Bohemia, for instance, as long ago as *fifty* years the elementary school grades taught—(*a*) What to do if a person had "breathed fire"; (*b*) What to do for a drowned person; and so on?

(10)—Do you know how long to keep up attempts at revival by artificial repiration?

A Bohemian farmer and his wife (on my farm in Geneva, Ohio) worked for five hours to revive their three-year-old daughter who had fallen into the pasture creek, had been in the water for almost half an hour and had turned blue. Mary heated the blankets to get and keep the child warm and Frank gave artificial respiration.

They were successful because of their childhood training at life-saving in Bohemia. Could you have done as well?

The answer is—"Whatever you do, don't give up! Don't give up until the doctor pronounces the victim dead. Don't trust amateurs on this point. Victims have been revived and lived normal, healthy lives, after hours of artificial respiration."

(11)—Have you cleaned out your own attic so that you could get at a fire in case of a bombing raid? Remember, if one comes, you and your children will have to put out your own fire. The Fire Department cannot answer an alarm at but one place at a time and *you are*, at such a time, *forbidden to use the telephone.*

(12)—Have you provided yourself with some asbestos or heavy leather gloves, a long-handled shovel, and the other tools needed to fight your own fires? Fire-resistant clothing is important.

REQUESTS BY READERS

(Under this heading will be carried the names of those who wish to be put in the way of "Keeping Up With Industry.")

950. *Requests on "How to Keep Up With Science and Industry in* **1942.**"

New Requests—

8. Robert W. Seaton, 205 Primrose St., Chevy Chase, Md.
"Please forward my name to Henry G. Weaver, Director of Customer Research Staff, General Motors Corporation, Detroit, Mich.',

Additional Trade and Other Publications

25. "Artificial Respiration"—An article in "The Employers' Pioneer," March, 1942, pp. 14, 15, 16.
"This article is available in reprint form for those taking A.R.P. or Red Cross First Aid courses. Please order by form number, p. 512." It is possible that Employer's Liability will send a single copy to a teacher. Write letter, enclose stamp, mail request to "The Employers' Pioneer, Arthur D. Grose, Editor, 110 Milk St., Boston, Mass."
26. "The Telephone in America"—Information Department, American Telephone & Telegraph Co., 195 Broadway, New York, N. Y. Quite likely your local telephone exchange has a copy. Your school or public library should surely have one.
27. "Chemical Pioneers"—The Founders of the American Chemical Industry, by William Haynes. Published by D. Van Nostrand Company, Inc., 250 Fourth Avenue, New York, $2.50.
This book will undoubtedly be in your Public Library.
28. "It Kills Hidden Fires"—*An advertisement* of Walter Kidde & Co., 924 West St., Bloomfield, N. J.—(Fire Extinguishers)

THE TRISECTION OF ANY ANGLE

A Mathematical Question with a Mechanical Answer.

951. *Proposed by Robert Torkelson (GQRA, No. 419), Central State Teachers College, Stevens Point, Wis.*
"Is it at all possible to trisect any angle?

Another answer—by Paul D. Thomas, U. S. Coast & Geodetic Survey, Lucedale, Miss. (Formerly Associate Professor of Mathematics, Southeastern State College, Durant, Oklahoma.) Elected to the GQRA, No. 429.

"Professor Robert C. Yates, (GQRA, No. 420), has just published a book whose title is *The Trisection Problem*. It is a complete historical and logical exposition of this famous problem. . . . Among the 43 figures which illustrate the text will be found more than a dozen mechanical devices for trisection. Particularly suitable for club activities, this book should be in the library of every high school and college."

Another answer by Clyde A. Bridger, Salt Lake City, Utah (GQRA, No. 157)

"In the general case, the trisection of an angle resolves itself into finding the solution of the cubic equation, $z^3 = \cos A + i \sin A$, by means of a finite member of square roots, one over another, of rational functions of $\sin A$ and $\cos A$, where z is a complex variable. This can happen only when the Riemann surface breaks down into separate pieces. (Quotes and the general proof of impossibility are given in Felix Klein's "Elementary Mathematics from an Advanced Standpoint," Hedrick & Noble's translation (1932) pp. 114, 115.

"Some of the old-time geometries (around 1890) included chapters on higher plane curves. Included was usually a geometrical proof of angle trisection starting with a conveniently chosen cubic curve."

(Note: Such a constructional demonstration is *not* a geometrical proof. ED.)

NEW PROBLEMS FROM CHICAGO

From some students in Wilson Junior College, Chicago, Ill. Submitted through Miss Annellyn Day, Secretary of the Science Club (Elected to the GQRA, No. 423.)

964. *Proposed by Walter Troll, Wilson Junior College, Chicago, Ill. (Elected to the GQRA, No. 424.)*

Why are cadmium and mercury always used in the Weston Cell?

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965. *Proposed by Ernest Lang, Wilson Junior College. (Elected to the GQRA No. 425.)*

"I would like to know how to make up a buffer solution that has a *p*H of exactly 9."

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966. *Proposed by Harry Delfs, Wilson Junior College. (Elected to the GQRA, No. 426.)*

"I would like to know why all the windows in the vicinity of an explosion always shatter outward and never inward."

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967. *Proposed by Elliott Shubert, Wilson Junior College. (Elected to the GQRA, No. 427.)*

"I ran across the following problem on a scholarship examination and wonder what is the correct answer and if it is possible:

"256 g. of sulfur react with 896 cc. of chlorine at standard temperature and pressure. Find the simplest formula."

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968. *Proposed by Annelyn Day (GQRA, No. 423), Wilson Junior College.*

"I am curious to know if there is any simple definition of polymerization."

An answer. Century Dictionary says—"Polymerization—The apparent fusion or union of two or more molecules of a compound, forming a more complex molecule with a higher atomic weight and somewhat different physical and chemical properties." (What is obviously wrong, if anything; and what is a correct and simple definition?)

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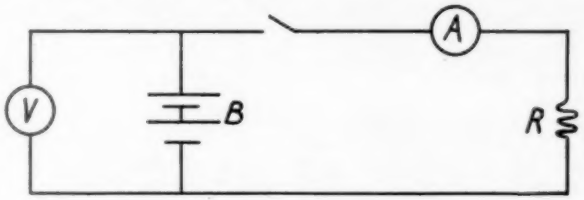
969. *Proposed by Physics Class, Wilson Junior College, through Miss Annellyn Day (GQRA, No. 423).*

"Our Physics class seems always to have difficulty with the following problem and I would like to see if anyone else has the same trouble:—

The battery, *B*, has an internal resistance of 1.5 ohms. *R* is a resistance of 10.5 ohms. When the switch is closed, the ammeter reads 2 amperes. What is the voltmeter reading then? What will the voltmeter read when the switch is open? Explain fully."



NEW QUESTIONS FROM CLEVELAND

Proposed by Harland M. Bright, Head, Department of Science, West High School, Cleveland, Ohio (Elected to the GQRA, No. 428.)

970. In a simple doorbell transformer, no current flows through the primary even though it is connected across the line until the push-button in the secondary, which is the bell circuit, closes the circuit. Why does current then flow in the primary?

971. What is the nature of current in the secondary of an ignition coil true alternating, or lop-sided alternating which pulsates much stronger in one direction than in the other?

972. Why does the efficiency of a Diesel engine tend to be greater than that of a gasoline engine?

973. How many propellers does a torpedo have and why?

974. What is the motive power of a torpedo?

Teachers, pupils, classes, and individuals are invited to answer questions proposed either by others or by themselves and to propose any questions on any portion of the field of science that they believe will be interesting, or stimulating, or valuable to the teachers, pupils or general readers.

We shall endeavor to get answers to all reasonable questions. It is always valuable to receive and publish the questions whether answers are available or not.

Classes and teachers are invited to join with others in this co-operative venture in science.

Contributors to SCIENCE QUESTIONS are accepted into the GQRA (Guild of Question Raisers and Answerers).

JOIN THE GQRA!

BOOKS AND PAMPHLETS RECEIVED

INTERMEDIATE ALGEBRA FOR COLLEGE STUDENTS, by Thurman S. Peterson, Ph.D., *Assistant Professor of Mathematics, University of Oregon.* Cloth. Pages viii+358. 13×20 cm. 1942. Harper and Brothers, 49 East 33rd Street, New York, N. Y. Price $1.85.

AERODYNAMICS FOR MODEL AIRCRAFT, by Avrum Zier. Cloth. 259 pages. 14×21.5 cm. 1942. Dodd, Mead and Company, 432 Fourth Avenue, New York, N. Y. Price $3.00.

ELEMENTARY GENERAL SCIENCE, Book III, Edited by J. M. Harrison, *Senior Science Master, Bristol Grammar School.* Cloth. 247 pages. 12×18.5 cm. 1941. Longmans, Green and Company, 55 Fifth Avenue, New York, N. Y. Price $1.60.

GENERAL CHEMISTRY, A FIRST COURSE, by Leona E. Young, *Associate Professor of Chemistry, Mills College;* and C. W. Porter, *Professor of Chemistry, University of California.* Cloth. Pages xi+644. 14.5×23 cm. 1940. Prentice-Hall, Inc., 70 Fifth Avenue, New York, N. Y. Price $1.95.

BIOLOGY FOR BETTER LIVING, by Ernest E. Bayles, *Associate Professor of Education, University of Kansas;* and E. Will Burnett, *Assistant Professor of Education, Stanford University.* Cloth. Pages xiv+754. 16×23 cm. 1942. Silver, Burdett Company, 45 East 17th Street, New York, N. Y. Price $2.28.

NUMBER READINESS SERIES, by Harold G. Campbell, *Superintendent of Schools, City of New York;* F. Lynwood Wren, *Professor of the Teaching of Mathematics, George Peabody College for Teachers;* and Worth J. Osburn, *Professor of Education, University of Washington.* Discovering Numbers, Grade III, pages vii+280. Number Experiences, Grade IV, pages iv+248. Number Activities, Grade V, pages viii+247. Exploring Numbers, Grade VI, pages vii+264. Cloth. 12.5×20 cm. 1942. D. C. Heath and Company, 285 Columbus Avenue, Boston, Mass. Price 80 cents each.

MODERN MEDICINE, by Netta W. Wilson, *Minnesota Department of Health;* and S. A. Weisman, M.D., *Clinical Associate Professor of Medicine, University of Minnesota.* Cloth. Pages vi+218. 13.5×21.5 cm. 1942. George W. Stewart, Publisher, Inc., 67 West 44th Street, New York, N. Y. Price $2.00.

MATHEMATICS IN DAILY USE, by Walter W. Hart, *Author of Mathematics Texts;* Cottell Gregory, *Louisville Girls High Achool, Louisville, Kentucky;* and Veryl Schult, *Supervisor of Mathematics, Divisions I–IX, Washington, D. C.* Cloth. Pages vii+376. 13×20 cm. 1942. D. C. Heath and Company, 285 Columbus Avenue, Boston, Mass. Price $1.32.

PORTRAITS OF FAMOUS PHYSICISTS WITH BIOGRAPHICAL ACCOUNTS, by Henry Crew. Size 25.5×34.5 cm. 1942. Scripta Mathematica, 186 Street at Amsterdam Avenue, New York, N. Y. Price of the Portfolio is $3.75.

ECONOMIC GEOGRAPHY, by Clarence Fielden Jones, Ph.D. *Professor of Economic Geography, Clark University*, in Collaboration with Gordon Gerald Darkenwald, Ph.D. *Instructor in Geography, Hunter College of the City of New York*. Cloth. Pages xxii+629. 18×25 cm. 1941. The Macmillan Company, 60 Fifth Avenue, New York, N. Y. Price $4.25.

DISCOVERY PROBLEMS IN CHEMISTRY, by Theodore E. Eckert, A.B., *Department of Science, Hempstead High School, Hempstead, New York;* Harley K. Lyons, M.A., *Department of Science, Walnut Hills High School, Cincinnati, Ohio;* and Wallace H. Strevell, M.A., *Supervising Principal, Ellenville Public Schools, Ellenville, New York*. Paper. Pages viii+344. 19.5×26.5 cm. 1942. College Entrance Book Company, Inc., 104 Fifth Avenue, New York, N. Y. Price 75 cents.

A FIRST COURSE IN ALGEBRA, by N. J. Lennes. Revised Edition. Cloth. Pages xiii+562. 13×20 cm. 1942. The Macmillan Company, 60 Fifth Avenue, New York, N. Y. Price $1.56.

CALCULUS, by Alfred L. Nelson, *Professor of Mathematics;* Karl W. Folley, *Associate Professor of Mathematics;* and William M. Borgman, *Assistant Professor of Mathematics, Wayne University*. Cloth. Pages x+356. 15×23.5 cm. 1942. D. C. Heath and Company, 285 Columbus Avenue, Boston, Mass. Price $2.75.

MODERN-LIFE SCIENCE, by Robert H. Carleton, *Summit High School, Summit, New Jersey;* and Harry H. Williams, *Horace Mann School for Boys, New York City*. Cloth. Pages x+650. 14×23 cm. 1942. J. B. Lippincott Company, 333 West Lake Street, Chicago, Ill. Price $2.40.

EXPLORING SCIENCE, Book 1, by Victor C. Smith, *Department of General Science, Ramsey Junior High School, Minneapolis, Minnesota;* and Gilbert H. Trafton, *Department of Biology, State Teachers College, Mankato, Minnesota*, in Consultation with W. R. Teeters, *Supervisor Physical and Biological Sciences, St. Louis Public Schools, St. Louis, Missouri*. Cloth. Pages xii+458. 13.5×21 cm. 1942. J. B. Lippincott Company, 333 W. Lake Street, Chicago, Ill. Price $1.32.

ENJOYING SCIENCE, Book 2, by Victor C. Smith, *Department of General Science, Ramsey Junior High School, Minneapolis;* and Gilbert H. Trafton, *Department of Biology, State Teachers College, Mankato, Minnesota*, in consultation with W. R. Teeters, *Supervisor Physical and Biological Sciences, St. Louis Public Schools, St. Louis, Missouri*. Cloth. Pages xii+596. 13.5×21 cm. 1942. J. B. Lippincott Company, 333 West Lake Street, Chicago, Ill. Price $1.52.

USING SCIENCE, Book 3, by Victor C. Smith, *Department of General Science, Ramsey Junior High School, Minneapolis, Minnesota;* and Gilbert H. Traftom, *Department of Biology, State Teachers College, Mankato, Minnesota*, in consultation with W. R. Teeters, *Supervisor Physical and Biological Sciences, St. Louis Public Schools, St. Louis, Missouri*. Cloth. Pages xiii+802. 13.5×21 cm. 1942. J. B. Lippincott Company, 333 West Lake Street, Chicago, Ill. Price $1.80.

THINKING THROUGH GEOMETRY, Books I and II, by J. Herbert Blackhurst, *Professor of Education, Drake University;* and Christine V. Brannan, A.M., M.S. Paper. 125 pages each. 21×27.5 cm. Book I, 1941, Book II, 1942. Blackhurst Book Company, Des Moines, Iowa. List price, each 75 cents, net 60 cents.

PUPIL PERSONNEL SERVICES AS A FUNCTION OF STATE DEPARTMENTS OF EDUCATION, by David Segel, *Consultant in Tests and Measurements;* and Maris M. Proffitt, *Consultant in Guidance and Industrial Education.* Bulletin 1940, No. 6. Pages vi+84. 14×23.5 cm. Superintendent of Documents, Washington, D. C. Price 15 cents.

TECHNIDATA HANDBOOK, by Edward L. Page, B.Sc. Paper. 64 pages. 13×21.5 cm. 1942. The Norman W. Henley Publishing Company, 17–19 West 45th Street, New York, N. Y. Price Spiral Binding $1.00, Cloth Binding $1.50.

SELLING HOME FURNISHINGS prepared by Roscoe R. Rau, *Executive Vice President and Secretary, National Retail Furniture Association;* and Walter F. Shaw, *Regional Agent, Business Education Service, U. S. Office of Education.* Bulletin No. 216. Pages viii+275. 14×23.5 cm. Superintendent of Documents, Washington, D. C. Price 45 cents.

FRACTIONS: WHY THEY ARE DIFFICULT AND THE REMEDY, AND OTHER PAPERS ON BASE EIGHT ARITHMETIC, by E. M. Tingley, *221 North Cuyler Avenue, Oak Park, Ill.* Paper. 19 pages.

THE ROCKEFELLER FOUNDATION, A REVIEW FOR 1941, by Raymond Fosdick. Paper. 64 pages. 15×23 cm. 1942. The Rockefeller Foundation, 49 West 49th St., New York, N. Y.

BOOK REVIEWS

OUTLINES OF GEOLOGY, by Chester R. Longwell. *Henry Barnard Davis Professor of Geology in Yale University,* Adolph Knopf, *Sterling Professor of Physical Geology in Yale University,* Richard F. Flint, *Associate Professor of Geology in Yale University,* Charles Schubert, *Professor Emeritus of Paleontology in Yale University,* and Carl O. Dunbar, *Professor of Paleontology and Stratigraphy in Yale University.* 2d Edition. Cloth. Pages ix+381 and ix+291. 23.5 cm.×16 cm. 1941. John Wiley and Sons. Inc. New York. Price $4.00.

This volume is a combination of Outlines of Physical Geology by Longwell, Knopf and Flint and Outlines of Historical Geology by Schuchert and Dunbar. The former consists of 18 chapters, an appendix and index; the latter of 13 chapters, an appendix and index. Maps, photographs and diagrams are used throughout the text, 281 furnishing illustrative material for the Physical Geology and 176 for the Historical Geology. The photographs are unusually fine, many being full page or half page illustrations. They contribute much to the attractiveness and value of the volume.

The text holds the attention of the reader. The chapter headings, particularly in the portion dealing with Historical Geology, are intriguing and the chapters themselves challenging and enlightening. The chapters dealing with Physical Geology present many practical aspects of geology and are most timely.

VILLA B. SMITH

EYE HAZARDS IN INDUSTRY, by Louis Resnick, Coauthor, "Eye Hazards in Industrial Occupations." Cloth. Pages xx+321, 16×23 cm. 1941. Columbia University Press, New York, N. Y. Price $3.50.

This book was written to serve as a handbook for safety engineers, safety inspectors, and all other actively engaged in accident prevention generally

and sight conservation in particular or in industrial efficiency, as well as a textbook by engineering schools, vocational training authorities, and all others engaged in preparing youth for work in industry.

The material contained in this book is the result of the author's contacts with the problem of eye hazards in factories, mills, mines, railroad shops, utilities, and other work places throughout the country, supplemented with personal observations of what was being done by industries of England, France, Switzerland and other European countries to guard the eyes of factory workers.

The subject matter is divided into two major parts. Part I presents the problem of eye injuries under the following chapter headings: I—Eye Hazards; II—Eye Accidents; III—Eye Diseases; IV—Defective Vision; V—First Aid. Part II is devoted to the solution of the problem under the following chapter headings: VI—Mechanical Guards; VII—Process Revision; VIII—Proper Lighting; IX—Education; X—Administrative Supervision.

The subject matter is well illustrated throughout by a number of excellent photographs and diagrams which add much to the effectiveness of the book as a text. There is also much valuable material contained in the appendices under the following topics: I—A Self-Appraisal for Eye Safety in Industry; II—Industrial Poisons Which Are Hazardous to the Eyes; III—Recommended Minimum Standards of Illumination for Industrial Interiors; IV—Some National Organizations Concerned with Industrial Welfare. A bibliography containing an extensive list of references is appended for those who desire additional material on this subject.

This book should be required reading for all who are engaged in accident prevention or the preparation of youth for work in industry. Conservation of vision of American workmen is as vital to national defense as are the building of armament and the training of men to use defense equipment. Good eyesight is a primary prerequisite to skilled craftsmanship.

HILMER C. NELSON
Wilson City College, Chicago

COMMUNITY HYGIENE, by Dean Franklin Smiley, *Professor of Hygiene, Cornell University*, and Adrian Gordon Gould, *Assistant Professor of Hygiene, Cornell University*. Third Edition. Cloth. Pages xi+448. 15×21 cm. 1941. The Macmillan Co., 60 Fifth Avenue, New York, N. Y. Price $2.50.

This text is a revision of a well known book designed for the use of classes in Community Health and Hygiene, but it contains material which will be of much interest to the general reader. The authors have included in their book for the first time the new knowledge of air borne infection based on Well's work, the broader conception of weather in relation to health, the scavenger action of the soil, food deficiencies, the changing emphasis in tuberculosis from control to eradication, the re-evaluation of the medical examination in the school health program, the various effects of the Wage and Hour Act of 1938 on industrial hygiene, the newer military medical problems created by air service, bombing and mechanized warfare, our changing conceptions of what is "adequate" in hospital and medical care, the recent forms of hospital insurance and voluntary health insurance, the new sulfonamide drugs, the revised Food and Drugs Act and the expanding functions of government in the health field.

The new revision contains many excellent photographs and diagrams which will add much to the teaching value of the book. The problem of community health and hygiene is especially important during wartime in maintaining a high state of efficiency among workers in industry and also

in the population as a whole from which our armed forces are being drawn. Consequently an increasing amount of attention will be given to this subject. The book will serve as a valuable text for supplying information for the improvement of public health.

HILMER C. NELSON

NATURAL HISTORY AND THE AMERICAN MIND, by William Martin Smallwood, *Chairman, Department of Zoology, Syracuse University* in collaboration with Mabel Sarah Coon Smallwood. Cloth. 16×23.5 cm. Pages xiii+445. 8 illustrations. Columbia University Press, New York, 1941. $4.25.

This interesting book is a comprehensive, narrative record of how early American naturalists from the time of the settlement of Virginia until about the middle of the nineteenth century, have influenced the cultural life of this country. The book shows how the naturalist of early days took the whole field of natural phenomena as his particular effort. He was inclined to fit his explanation of nature to the extant philosophies of his day. The book carries one to the threshold of the beginning of the modern scientific era which began about the middle of the last century. This book commends itself in the field of education to the teacher of science. The teacher will understand better the struggle which has gone on in the past and is still evident, for pedogogical recognition of the various discrete disciplines in the natural science field, which we know as biology, geology, mineralogy, paleontology and zoology. These fields are continually being refined and subdivided and if one is not intellectually careful one is likely to become somewhat bewildered. An understanding of how philosophies develop out of science should forestall any such bewilderment. The contents are: I—Early Writings on American Natural History. II—Natural History in the Colleges, 1640–1790. III—What Americans Studied in European Universities. IV—Some Early Cultural Centers. V—Diffusion of Natural History Culture. VI—The Contribution of Publishers, Artists, And Engravers to the Science of Natural History. VII—The Part Played by the Microscope. VIII—The Philosophy of the Naturalist. IX—Amos Eaton and the Academies. X—Early Teaching of Natural History in the Colleges. XI—Natural History Struggles for Academic Recognition. XII—The Passing of the Naturalist.

References consulted were 100 manuscripts, 727 printed works and 41 periodicals and newspapers. These form the bibliography; however this is not to be considered a complete bibliography.

A. G. ZANDER

CURRENT PRACTICES IN INSTITUTIONAL TEACHER PLACEMENT, written by thirty-five members of the National Institutional Teacher Placement Association. Editorial Committee: Earl W. Anderson, *Ohio State University;* John Douglas Leith, *Teachers College, Columbia University;* and Ralph F. Strebel, *Chairman, Syracuse University*. Cloth. xii+186. 2×15×23 cm. 1941. Published by National Institutional Teacher Placement Association.

This book has been prepared by members of the National Institutional Teacher Placement Association as a companion volume to *Institutional Teacher Placement* published by the Association in 1937. The present volume describes actual practices carried on throughout the country. It may be used as a helpful source book of current practice in the field.

The Association published the volume with the assistance of The Division on Child Development and Teacher Personnel Commission on Teacher Education, American Council on Education.

A weakness occurs on the title page in that no address of publication is given.

JOSEPH J. URBANCEK
Chicago Teachers College

ENGINEERING DRAWING, by D. E. Hobart, *Assistant Professor of Mechanism and Engineering Drawing, University of Michigan.* 1st Edition, pages vii+430. 699 figures. 16×24 cm. Cloth. List Price $2.75. D. C. Heath and Co. New York. 1941.

This recent excellent text on engineering drawing has joined the ranks of several others that have been published within the past several years. It is noteworthy to observe that within its covers, the subject matter is adequate to meet the modern needs of teaching in this field. The author has avoided the encyclopedic character that some current texts are beginning to exhibit. The content is progressive, with sequence that is easy to follow. The student will find the text readable with helps along the way that are lucid and sufficient.

The section dealing with "Developments and Intersections" introduces graphic fundamentals and nomenclature with suitable applications not always found in a book of this kind. Edited and delineated to professional standards it also reflects the depth of understanding the author has gathered from his teaching experience.

LUMIR P. BRAZDA
Wilson City College, Chicago

ECONOMIC GEOGRAPHY, by Clarence F. Jones, *Professor of Geography, Clark University;* in collaboration with Gordon G. Darkenwald, *Instructor in Geography, Hunter College of the City of New York,* 629 pages, 1941, The Macmillan Company, New York. Price $4.25.

The subject matter of economic geography can be organized and presented along any one of three general plans: regional, commodity, or occupational. The first two have been used by various writers, but this is the first college text to follow the occupational approach. Personally, I like it. The encyclopaedic enumeration of facts for one region after another or one commodity after another is absent. Then too, this plan better facilitates the natural grouping of related activities and industries. The authors place particular emphasis upon types of farming, another departure from the usual procedure.

Most texts in economic geography contain a detailed discussion of agriculture, but an inadequate treatment of mining and manufacturing. That has been avoided in this case, for more than 100 pages have been devoted to each of these occupations. If for no other reason, this should lead teachers to give the book more than a cursory examination. The book is written in a simple, vivid style and stereotyped discussions are avoided. It contains a wealth of new material which probably results largely from the extensive experience of the senior author. The textual material is illustrated by four hundred maps, bar graphs, and well chosen pictures.

The maps and graphs are well drawn, but even so the reviewer is disappointed. The authors do not give the date of the statistics used. Economic geography is a changing subject. Teachers and students alike want to know if they are receiving a picture of current conditions. In some instances they are not. For example, a map showing petroleum production by states places Illinois in 11th position with only one-half of one per cent of the national total. That was true before the new fields were opened in 1937. Illinois is now in fourth place with approximately one-eighth of the total. The map of pipe lines is also out-of-date for the same region. There is no

indication that mineral production is important in the Philippines. Until 1935, it was insignificant, but the islands now rank fifth in the production of both gold and chromite and are the tenth ranking manganese producer. This then leads one to believe that the section on mining is based on statistics of 1935. However, this one criticism, though significant, should detract only slightly from the general value of the text.

ALDEN CUTSHALL
University of Illinois

CLOUDS, AIR AND WIND, by Eric Sloane. Cloth. 76 pages. 22.5×30.5 cm. 1941. The Devin-Adair Company, 23 East 26th Street, New York, N. Y. Price $2.50.

In this tall, thin volume, Eric Sloane offers a rather curious mixture of paintings, cartoons and text. It represents an attempt to familiarize the average individual with how the various cloud formations originate, how to distinguish them and how the wind and air behave in general.

The first half of the book is a collection of paintings clearly showing the individual characteristics of cloud forms. In each he includes an airplane to give a pilot's-eye view. On the opposite page the text describes the cloud and points out the differences between the one formation and others similar to it.

In the second half, the paintings are replaced by cartoons illustrating with humorous, homely touches, the more technical aspects of cloud formation and general meteorology. The more serious explanatory text on the opposite page is continued. To the casual glance, the cartoons may seem a bit incongruous, but they make the subject much more understandable to the layman than pages of text. Summer and winter storms, air currents, wind, flying weather, how to read weather maps are among the topics discussed and illustrated, and in each case they are closely related to the pilot's life. The book is brief, but it puts the material across in a way that young and old will enjoy. Many, after reading it, will be provoked to a further study of that most familiar topic of conservation, the weather.

EUGENE D. HART
Enoch Pratt Free Library

MATHEMATICS FOR THE AVIATION TRADES, by James Naidich, *Chairman, Department of Mathematics, Manhattan High School of Aviation Trades.* Cloth. Pages x+267. 15×23 cm. 1942. McGraw-Hill Book Company, 330 W. 42nd Street, New York, N. Y. Price $1.80.

This book is written as a text for students in trade schools who intend to become aviation mechanics. The author is the chairman of the mathematics department in the Manhattan High School of Aviation Trades, and thus has first hand knowledge both of the kind and scope of aviation problems which the future mechanic must learn to master, and of the kind and scope of the arithmetic and geometry prerequisite for their mastery.

Wisely not taking for granted "what should have been taught in the grades" the author devotes almost half of the text to the building up of exactly the mathematical background needed: fractions, measurements of lengths, areas, volumes, weights, measurements of angles, simple constructions with compass and ruler, and various forms of graphical representations. All this is done with a minimum of theory and a maximum of concreteness. Fractions, e.g., are treated as the readings on rulers or on the head of the micrometer caliper. Operations with fractions grow out of the problem of finding lengths, areas, volumes, etc., whose dimensions are expressed in different kinds of fractional units.

The second half of the book is devoted to the study of specific problems concerning airplane construction from the point of view of the mechanic. A first part deals with airplane wings, calculation of wing areas, and the drawing of airfoils according to given numerical specifications. A second part treats of the strength of materials relative to various kinds of stresses. The last part is concerned with certain numerical aspects of the airplane engine such as horse power, oil and fuel consumption, compression ratio and valve timing.

The presentation is admirably suited to the purpose. The meaning and significance of the various technical terms is briefly and concisely explained; formulas are stated; after which follows a wealth of practical problems calling for numerical calculations with all manner of conversion of units and use of constants to be taken from tables; graphical representations, interpolations, and the like. Spaced and printed with utmost clarity the book also abounds in excellent figures, many of which are taken from aviation journals.

Although designed for a very special class of students the book should be of greatest interest to mathematics teachers in general as a rich source of illustrative material for arithmetic and geometry courses from a field which, particularly in these days, is of such absorbing interest to many students.

LUISE LANGE
Wilson City College, Chicago

MATTER, ENERGY AND RADIATION, by J. R. Dunning, *Associate Professor of Physics, Columbia University*, and H. C. Paxton, *Instructor in Physics, Columbia University*. First Edition. Cloth. Pages xvi+668. 15×22.5 cm. 1941. McGraw-Hill Book Company, 330 W. 42nd Street, New York, N. Y. Price $3.50.

This is the first of a series of four texts designed to cover a two-year sequence in science at Columbia College. This is a textbook of physics except for a section on astronomy covering about 140 pages of historical and expository matter. The first chapter of physics (Chapter IV, Properties of Matter) covers not only the ideas usually discussed under this heading in the standard physics texts but also borrows many topics from heat, light, and electricity. Chapter V, Atoms and Molecules, gives fundamental facts which lead to the idea of elementary particles but the kinetic theory of matter is not developed until after a quite thorough study of energy, which is the theme of Section III. This section follows closely the orthodox plan of standard physics texts; mechanics, heat, wave motion and sound, electricity, with chapters on atomic and molecular energy, meteorology, and applications in industry and transportation. Section IV gives an excellent elementary treatment of radiation with particular emphasis on radio communication, spectra, and atomic structure and transmutation.

This is not an ordinary survey text in physical science but is suited to the needs and abilities of serious students of physics who are willing and competent to master fundamentals. It is not heavily loaded with mathematics, neither is mathematical treatment avoided. The m.k.s. system is used throughout. Chapter summaries, lists of questions, and supplementary reading references are given. An appendix outlines a short laboratory course to accompany the text. The illustrations are aptly chosen; the diagrams are large and clear; all illustrations are completely labelled and accompanied by suitable legends; the language is simple and understandable; the typography and mechanics of the book are of highest grade. This text should appeal to all liberal arts students.

G. W. W.

THIS PHYSICAL WORLD, by C. C. Clark, *Associate Professor of General Science, New York University;* C. A. Johnson, *Instructor in General Science, New York University;* and L. M. Cockaday, *Lieut. Comdr., U. S. N., Military Instructor in Physics, United States Naval Academy.* Cloth. Pages x+528. 15×23 cm. 1941. McGraw-Hill Book Company, Inc., 330 W. 42nd Street, New York, N. Y. Price $3.25.

This is the first of a two-volume series aiming to give a complete survey course in science at the college level. It is very attractive in appearance, extraordinarily reliable for a book of this type, almost entirely expositional, nearly devoid of mathematics. It is well adapted to catch and hold the interest of the typical non-science student but it is likely to leave him with little appreciation of the work of scientists and of the difficult road along which science has advanced. Nor will he have acquired much real science education because no analytical thinking is demanded. No doubt successful survey texts must be of this type, but it would be a great step forward if some superteacher could write a book that would lead survey students into real science education.

The authors start with a short chapter intending to give the student some ideas about the laws of nature, the scientific method of study, the importance of measurement and the changes being brought about by the applications of science. Two chapters on astronomy follow, then four chapters on atomic structure, chemical compounds, chemical changes, and applications of chemistry. The remainder of the book, 280 pages, is devoted to topics from physics with emphasis on heat and heat engines, wave motion, radiation and electronics. The authors have avoided the older and more prosaic sections of physical science in order to have space for the more attractive topics now on the front page of the popular magazines. The text is worthy of careful consideration by all teachers of survey science.

G. W. W.

EXPERIMENTAL FOUNDATIONS OF GENERAL PSYCHOLOGY, by Willard L. Valentine, *Professor of Psychology, Northwestern University.* Cloth. Pages xvi+432. 1941. Farrar & Rinehart, Incorporated, New York, N. Y.

The reading of but a few pages of this text reveals the painstaking accuracy of the author in reporting experiments and his keen criticism in evaluating them. After finishing the work, the reader admires exceedingly the apt selection of topics in the very extensive field of psychology, the happy choice of experiments for each of these topics from among the encyclopedic multitude of experiments, and the well constructed organization of the whole. Praiseworthy is the skill of the author in reporting the individual experiments briefly, while at the same time, adequately, with the result that the reader is almost always interested. In the few places where the reading of experiments is laborious, the length and complexity of the experiment are the causes. Highly commendable, also, is the author's simplicity of language, due not only to his writing ability but also to his purpose as stated in his preface to the second edition, "To eliminate as much of the technical vocabulary as possible." It would aid the understanding of the sciences and eliminate overestimates of their accomplishments if their technical language were diminished. In each science, perhaps in psychology more than in any other, the extent of technical terms has grown to such proportions that even a trained person cannot read the literature of his own science without keeping constantly at his elbow a technical dictionary.

Although throughout this book, the author is very critical in evaluating experiments, frequently indicating the unjustified inferences drawn in them, he also, in a few instances, goes beyond the evidence of experiments. The continued gain in I.Q.'s in each repetition of the Otis Group Test over an interval of a year may have as its possible cause increase in age (page 122). The statement on page 184 that in the experiment on conditioned reflex "white" became a symbol of food is going beyond the evidence; mere association of "togetherness" may explain the reaction of the rats. Words do not merely become equivalent to objects in releasing responses; if they merely do this, words are conditioned reflexes and not symbols. When a word through its association of "togetherness" with the object becomes a symbol it need not cause any of the reactions of the objects beyond the cognitional ones, and it can be used in judgments. The prestige experiment of Binet and Henri (page 277) of having children draw from memory first a five centimeter line which they had been shown a few minutes before and then a four centimeter line which they had been shown but had been told was longer than the former line in order to find out whether the children let themselves be guided by suggestion rather than observation could be valid only on condition that the children possessed the acquired ability of recognizing the linear measures of the experiment and the acquired skill of drawing them. The Thorndike experiment (page 327) to test the effectiveness of mere repetition by having the subjects draw a four-inch line, eyes closed, at one quick movement cannot be valid except with subjects who can recognize a four-inch line. The inferences from this experiment are further conditioned by the problem of how quickly and how accurately a person can acquire the skill of drawing a five-inch line from memory and with eyes closed. Williams' experiment of non-prestige suggestion (page 278) in which children were to hold their fingers on a coil of wire ostensibly connected with a battery until they just barely felt the warmth to find out whether they followed the actual sensory stimulus or the suggestion of the coil and battery which actually had a current only on the pressure of a hidden button is vitiated because of the threshold values of the sensory stimuli. The inferences drawn from the letter sequence maze experiment, on page 333, in which a subject was to guess the correct letter of two letters recited to him until he made the correct selection in the entire series of two letters from the beginning to the end, being led to start from the beginning each time he erred, is hardly justified, and that for three reasons: because the auditory learning stimulus of mere letters is rather unusual to subjects, because the usually difficult learning of a nonsense syllable was the solution of the maze, and because the instructions did not clearly state the calling out of two more letters meant that the choice made on the calling out of the previous two letters was correct. The instructions read: "I call out two letters at a time, and you are to choose one of them; then I call out two letters more, and so on, until you get to the goal." Such experiments for testing intelligence as that of Ruger, on page 378, in which subjects were to separate two intertwisted nails is of little or no value. For it seems to be difficult to solve such problems intellectually. At any rate comparisons between human beings and infra-human beings are of value only if they both are subjected to the same puzzle test. Dewey's statement, page 379, that problem solving occurs only when already learned reactions are found to be inadequate is only true in the field of practical knowledge—sometimes. There is frequently problem solving in the field of pure knowledge through mere curiosity, merely because we like to know what else there is besides what we already have found out. Similarly, his assertion that problem solving requires the making of hypotheses is contrary to practice. No doubt in the example

of trying to find out what a white pole seen at a distance was necessitated the making of hypotheses. In problems of such wide scope as the nature of light, of weight, of matter, and in any problem the solution of which is the finding of one of the premises which will make the facts of experience logical inferences, the formulation of hypotheses is required. In other problems, either a doubt or a curiosity is necessary, but hypotheses are not needed and sometimes are useless. These are two instances of the common fallacy of generalizing from insufficient survey of instances. On page 392, is the very usual apology for animal intelligence, "another hindrance to more complex accomplishment on the part of the chimpanzees is their complete lack of language mechanism." The natural question arises, "If the animals are intelligent, be it ever so little, why did they not invent a language?" Man has invented three: sound, sign, and braille. The infant that learns its mother tongue has to catch on all by itself that the sounds symbolize or mean things; so does the deaf-mute in regard to signs, and the blind deaf-mute in regard to braille. If a human individual (page 415) is the product of three factors—his structure, his immediate surroundings, and his history—it seems that he should hardly be able to improve himself beyond what he is, or to improve the world. But why except (page 426) from the past history of the human person "the language formulations of teachers, moralists, novelists, poets, philosophers, lawyers or politicians," if he was subjected to such stimuli? Certainly this book will be a part of the past history of the student if he reads it, as he ought.

In spite of these few criticisms, the text is of great value in revealing to the student the great care needed in making generalizations and the nature and refinement of experiments in the field of psychology. The book should be used as supplementary reading, not only by students of psychology, but also by other students.

ALEXANDER P. SCHORSCH
Dean of the Graduate School, De Paul University

FIRST YEAR COLLEGE MATHEMATICS, by Cleon C. Richtmeyer and Judson W. Foust, *Central Michigan College of Education*. Cloth. Pages xi+461. 15×23 cm. F. S. Crofts and Co. New York, N. Y. 1942. Price $3.25.

This textbook presents in one volume the work in freshman mathematics consisting of the traditional materials of algebra, trigonometry, and analytic geometry. A review of elementary algebra is presented in Chapter 1, functions and graphs in Chapter 2, and differentiation and integration in Chapter 3.

The function concept, according to the authors, has been used as a unifying principle, but the reviewer fails to understand what they mean by unification, when the traditional materials are presented as separate topics. Moreover, little use is made of differentiation in the work that follows Chapter 3, and integration is altogether forgotten. Even if unification is sought only in the same branch of mathematics, such as algebra, one wonders why the characteristic property of the exponential function is not presented in terms of the derivative, or in terms of the arithmetic and geometric sequences. One also wonders why the irrational function is presented but not the power function.

Considered from the viewpoint of a traditional organization, the text is well written. It has an ample supply of good problems and exercises. The exposition is concise and well illustrated. The teacher of freshman mathematics, who desires the contents of algebra, trigonometry, and analytic geometry in one volume, should examine this textbook for himself.

J. S. GEORGES

WHAT IS TRUTH? by Glen Hilding Draper, *Trustee, Research Institute Washington, D. C.; Associate-Astronomer, Mathematician of the United States Naval Observatory.* Pages vi+122. Ransdell, Inc., Washington, D. C. 1941.

"This book is an attempt to formulate a logical theory based upon the use of criteria for truth, and therefore is intended to be free of paradoxes and obsurdities." With this modest claim, the author, in the preface of his unusual book, challenges the readers "to be severely critical with the text, using their own intelligence, accepting nothing which they do not understand in physical terms."

Applying this criterion set forth by the author, the following have been selected by the reviewer as examples for reflective thinking by the mathematician or the scientist.

1. "There is no intrinsic truth in and of itself, truth is a term used in referring to an understandable relationship." P. 1.
2. "The intellect is that mental function which arbitrarily divides the universe, according to the points of view, into pertinent or relavent universes, each part equal to the infinite whole." P. 23.
3. "Finite is merely the ratio of two infinities of like observations one of which, in the ultimate, is fundamentally a property of the thinker himself." P. 33.
4. "Thinking without data-observations is nonsense and void of value." P. 36.
5. "Understanding is of course impossible without observation, reason, space, time, and matter." P. 26.
6. "If a statement is true, it will work, even though no observation has ever been made." P. 43.

Before going on further, let us apply the suggested criterion to the above statements.

According to (5), there is no understanding without observation. According to (1), there is no truth without understanding. According to (6), there is truth without observation and hence without understanding.

At this point before losing consciousness the reviewer recommends that the reader read the book for himself.

J. S. GEORGES

SIMPLE CHEMICAL EXPERIMENTS, by Alfred Morgan, Cloth. 269 pages, 13×19.5 cm. 1941. D. Appleton-Century Company, 35 W. 32nd Street, New York, N. Y. Price $2.00.

This is an instructive and fascinating book for the "home lab." boy. The author presents over 200 chemical experiments simplified so that the elementary science pupil can perform them with ease and safety. The experiments are grouped under such headings as "Experiments with Precipitates," "Experiments with Sulphur and Some of Its Compounds," "Experiments with Oxygen and Oxygen Compounds," "Experiments with Gases and Some of Their Compounds." There is a chapter on "Chemical Tricks and Magic," and a final chapter on "Practical Uses for Your Chemical Knowledge," such as removing stains, making aquarium cement, silver polish, and other interesting and simple applications. There are also over 80 simple but very clear illustrations by the author. This is another excellent book to place in the hands of the high school science student for reference. It will hold his interest, aid him in his project work, and make clear some of the material he finds difficult in regular school work. Moreover this book will help him develop an excellent chemical vocabulary.

M. J. W. PHILLIPS
High School, West Allis, Wis.

THE FLOWER FAMILY ALBUM, by Helen Field Fischer, *Radio Garden Consultant* and Gretchen Fischer Harshbarger, *Landscape Architect and Horticultural Illustrator*. Cloth. Pages 130. 28.5×22 cm. University of Minnesota Press, Minneapolis, Minn. 1941. Price $2.50.

Just the casual observer of flowers is fascinated by the interesting things revealed in this book. It is a book that would appeal to the average student if introduced to it by some of its interesting "gossip" stories. The family, be it weed, flower, or vegetable, has been brought together so that family resemblance is easily seen. Soon the reader uses the book much as a game to see how many he can recognize or how many he knows in each family. If the book served no other purpose it would show the student the value in classification. The book may be used by the student in collecting and making pressings of the various families in his environment which would resemble the illustrations that are given. The set-up of the book is excellent with the story of the family on the left page and excellent scale drawings with an extra enlarged flower to make identification easy on the right hand page. The pen drawings are excellent. The small varieties are so accurately drawn that a reading glass can be used to show up the details. It is grand to be able to refer constantly to the illustration by just turning the head instead of pages. Close observation and learning of the family becomes much easier. The common name, scientific name with its syllabication and pronunciation, is given under each illustration. More than fifty families are given. Some of the common ones are: Orchid, Buttercup, and Poppy. Some of those we are less familiar with are: Gesneria, Figwort, and Borage.

The book is exceptionally valuable to a Nature or Hobby Club. Those interested in providing material for further activity should read enough of the book to catch some of the interesting items that would introduce this book to the student.

PAULINE ROYT
High School, West Allis, Wis.

MATERIAL FACILITIES, NEEDED IN THE TRAINING OF INTERMEDIATE GRADE TEACHERS IN SCIENCE, by H. A. Cunningham, Ph.D. *Teachers College, Columbia University Contribution to Education*, No. 812. Bureau of Publications Teachers College; Columbia University, New York, 1940. Price $2.00.

This text is a study in which the author has succeeded in giving a very accurate description of the material facilities such as rooms, equipment, supplies, furnishings, and services most desirable for the training of intermediate grade (4, 5, and 6) teachers in science. The criteria for determining what should be most desirable was found in an extensive survey of: First, the courses of study, textbooks, and laboratory manuals used in both the intermediate grades and in the teachers' college; second, from material facilities actually used in teaching intermediate grade science and the training of intermediate grade teachers in science.

Data compiled from these primary sources were supplemented with data from several secondary sources such as scientific studies and findings in Science Education and in the sciences themselves and also from opinions of experts in the field of laboratory construction.

The book is valuable in that it emphasizes the experiences, generalizations, and activities necessary to give the students in science a meaningful picture of an orderly universe governed by material laws. The author found a lack of agreement between the various experiences and activities offered in the grades with those given in the college courses. The physical sciences designed to train the science teacher were found to be neglected

in the college courses. Something should be done to remedy this situation. The findings indicate that the teachers should receive their instruction from a survey course in science directed by one department rather than from the various departments in the many fields of science.

Above all, however, this book gives a rather ideal but very precise picture of material facilities which might be provided for in those teachers colleges and elementary schools which are sufficient in size and have adequate funds necessary to carry on such an ideal science program. This work sets up the very highest standards to be attained and gives science teachers and administrators much to think about in the way of improving present facilities and adjusting current courses of study to fit the needs and interests of both the students and teachers of science.

KATHRYN I. WENDT
Wendell Phillips High, Chicago

SECOND-YEAR ALGEBRA, by Raleigh Schloring, *Head of Department of Mathematics, The University High School, and Professor of Education, University of Michigan;* Rolland R. Smith, *Specialist in Mathematics, Public Schools, Springfield, Massachusetts;* with the co-operation of John R. Clark, *Teachers College, Columbia University.* Cloth. Pages xii + 484. 12.5×20.5 cm. 1942. World Book Company, Yonkers-on-Hudson, New York, N. Y. Price, $1.68.

After years of textbooks in mathematics written with the mathematics left out, it is refreshing to find one in which the authors state frankly in the preface: "The authors feel that those who elect a second course in Algebra do so primarily because they wish rigorous training for the mathematical sciences. . . . To meet the needs of such students this book has been written from the point of view of mathematics for mathematics' sake."

Written for three groups of learners—the bright, the average, and those who can master only a minimum course—there is presented for the first group a variety of optional material (starred), including a number of topics from analytic geometry, and an excellent chapter on *Rates of Change* which gives an introduction to the methods of the differential calculus. The third group omits all this and does the easier exercises of each list, the exercises being arranged in order of difficulty. In between these groups there is a wide choice of material for the pupil of average ability. Nor has the teacher himself been overlooked, for scattered throughout are footnotes addressed to the teacher containing valuable teaching suggestions. There is a profusion of historical notes and informational paragraphs to furnish vitality. A single rule for finding the characteristic (whether positive or negative) of a logarithm is given and interpolation is explained by means of diagrams. There are numerous reviews and each chapter concludes with a chapter test.

GLENN HEWITT
Von Steuben High School, Chicago

A FIRST COURSE IN TRIGONOMETRY, by W. J. Oliver, *Central Collegiate Institute, Regina, Saskatchewan;* P. F. Winters, *Scott Collegiate Institute, Regina, Saskatchewan;* and J. E. Campbell, *Central Collegiate Institute, Regina, Saskatchewan.* Cloth. 269 pages. 12.5×18.5 cm. 1941. School Aids and Text Book Publishing Company, Ltd., Regina and Toronto. Price, $1.25.

This is the most attractive text in plane trigonometry that has come to the attention of the reviewer. Explanations are well written and it is filled with attention-compelling diagrams and photographs to illustrate the

principles. Each chapter contains numerous exercises, lists of optional material and a summary. Numerous review exercises appear throughout. The problems are up-to-date and deal with such things as finding an airman's "ceiling" at night, refraction of light, projectiles and artillery, etc. An entire chapter is devoted to the ambiguous case.

Excellent as it is however, the text is capable of improvement. The authors fail to point out that interpolation is based on an assumption, and hence the student may get an erroneous idea from the statement at the top of page 62. The technical college may feel that inverse functions and radian measure should be introduced earlier than the last chapters and that the treatment of the former is somewhat brief. An index would make the book more useable to the student.

GLENN HEWITT

THE PHILOSOPHY OF ALFRED NORTH WHITEHEAD, Edited by Paul Arthur Schilpp, *Northwestern University*. Cloth. Pages xviii+745. 14.5×23 cm. 1941. 302 Harris Hall, Northwestern University, Evanston, Ill. Price $4.00.

This is Vol. III of *The Library of Living Philosophers*, the previous volumes dealing with John Dewey (1939) and George Santayana (1940). In the present volume, eighteen prominent scholars have written descriptive and critical appraisals of the philosophy of Professor Whitehead, under such titles as Whitehead's Philosophical Development; His Relation to Modern Logic; His Philosophy of Science; Space-Time, Simple Location and Prehension; A Biologist's View of Whitehead's Philosophy; Is Whitehead's Psychology Adequate?; His Philosophy of Language; His Defence of Speculative Reason; The Method of Speculative Philosophy; Whitehead on Mind and Nature; Philosophy of Organism and Physical Realism; Whitehead's Theory of Value; The Art-process and the Aesthetic Fact; Whitehead's Philosophy of Religion; His Idea of God; His Moral Philosophy; His Views on Education; and The Philosophy of Whitehead.

The scholarly contemporaries who have contributed these interpretations are Victor Lowe, Willard V. Quine, Filmer S. C. Northrop, E. B. McGilvary, Joseph Needham, Percy Hughes, Wilbur Marshall Urban, A. D. Ritchie, Arthur E. Murphy, William Ernest Hocking, Roy Wood Sellars, John Goheen, Bertram Morris, J. S. Bixler, Charles Hartshorne, Paul A. Schilpp, Henry Wyman Holmes and John Dewey. Professor Whitehead himself contributes three papers: his autobiography and two essays—"Mathematics and The Good" and "Immortality." The volume concludes with a bibliography of Whitehead's writings from 1879 to November 1941, a careful index of several thousand entries.

GLENN HEWITT

ALGEBRAIC SOLID GEOMETRY, by S. L. Green, *Senior Lecturer in Applied Mathematics, Queen Mary College, University of London*. Cloth. 133 pages. 11.5×18.5 cm. 1941. Cambridge, at the University Press. The Macmillan Company, 60 Fifth Avenue, New York, N. Y. Price $1.75.

This little book, printed in Great Britain, is based on a course of lectures given over a period of twenty years to the students of Queen Mary College, University of London. The topics presented are: direction-cosines of a line, the plane and the straight line, the sphere, the central quadrics, the para-boloids and the cone. Some of the exercises are taken from recent final examinations at the University of London.

GLENN HEWITT

THE FOUNDATIONS OF CONSERVATION EDUCATION, by Henry B. Ward (editor) et al. Cloth. Pages 242. 12×19 cm. 1941. The National Wildlife Federation, 1212 Sixteenth St., N. W., Washington, D. C.

The book consists of a series of articles prepared independently by seven authors. It constitutes pamphlet #3, authorized and made ready for print by the Committee on Conservation Education. The six topics presented are: Conservation, Liberty and Economics—Conservation of Soil as a National Resource—The ABC of Conservation—The Pitfalls of Conservation—The Role of Applied Science in Conservation and Its Relation to Wildlife—Biology as the Foundation of Conservation Education. The book presents a number of new features on the conservation movement, and the spirit which forms the basis of the publication is of sufficient import that the book ought to be read by every biology teacher. Primary stress is placed on conservation of soil, water, and the biological balance. Several articles seem to overlap in subject matter and so give the impression of needless repetition. To the reviewer the articles on pitfalls of conservation, the role of applied science in conservation, which stress the problems involved in planning and carrying out conservation projects; and the brief review of soil erosion and loss of ancient civilizations were of chief interest. The article on biology teaching brings some thought-provoking facts but in its third part it is too negatively critical of present-day teaching and textbooks in biology. The investigation appears one-sided, guided by a fixed idea. It is an easy matter to say biology ought to be taught in the outdoors, but it is quite a different matter to be able to carry out such teaching successfully. The teacher is confronted by a number of problems over which he has no control. A few of these are: time allotment on which balanced curricula are built, biology courses are assigned to periods between other types of instruction and so students must be in the building exactly on time; the problem of change to shoes and clothing adapted to outdoor study; in large cities, the problem of transportation and cost of it. Most teachers in high schools and colleges are not narrow specialists, many of them had training in field courses at biological stations, but the problems enumerated above are serious obstacles which limit teaching in the outdoors to a few field trips. I also do not agree with the author that the Agassiz group had more success than our present-day teachers. The numerous students preparing for biology teaching, garden clubs, nature study groups, bird study groups, conservation clubs, visitors at botanical gardens, etc., etc., are to me concrete evidence that our biology teachers have enthused and are doing a fine job at teaching. Conservation is a new field, so give it time to be assimilated in time-tried courses. High school teachers are incorporating conservation into their biology courses. Evidence of this is the annual report for 1941 of the conservation committee of our own organization. To me the article would have been of more practical value if the author had given a detailed account of how he solved the problems of field work in biology, and how he conducts his classes in the open.

J. E. POTZGER
Butler University
Indianapolis, Indiana

THE MICROBE'S CHALLENGE, by Frederick Eberson, Ph.D., M.D., *Director of Laboratories, Pathologist, Gallinger Hospital, Washington, D. C.* Cloth. 18×26 cm. Pages viii+349. 2 photographs. Map. Index. Glossary. The Jaques Cartell Press, Lancaster Pennsylvania. 1941. $3.50.

This book has a story of vital interest to everyone, scientist, philosopher, physician and layman. To the physician it is a record of the progress of

preventative medicine, to the scientist a vindication of the scientific method and all its implications, to the philosopher the inevitable result of philosophic findings, science. To the layman it shows the almost superhuman perseverence of investigators seeking to reduce the terrors and hoping to eliminate some of these terrors of disease. A refreshing philosophy at times appears in these pages. In illustration I quote, "From a detached biological point of view, a human embryo differs slightly, if at all, from a tapeworm or any bloodsucking insect. This is merely to say that parasitism, as a perfectly natural occurrence, is not necessarily a vicious habit, but rather an incident of life common to all its forms.—The make a confession, scientific truths do at times become disconcerting and embarrassing."

The chapter headings are: I—The Simple Life. II—The Times Change. III—The Way of a Parasite. IV—Changeable Microbes. V—Jekyll and Hyde Types. VI—Chemistry and Behaviour. VII—The Borderland—Animate or Lifeless. VIII—Virus Riddles. IX—Little Microbe—What Next? X—Microbes Run Amuck. XI—Epidemics To Order. XII—The Challenge.

A. G. ZANDER

WORKING WITH THE MICROSCOPE, by Julian D. Corrington, Ph.D. *Professor of Biology, Washington College, Chesterton, Maryland; Editor, Microscope Department, "Nature Magazine"; Permanent Secretary, American Society of Amateur Microscopists; Author of "Adventures with the Microscope."* Cloth. 16×23.5 cm. Pages xi+418. Illustrations 105. Index. Whittlesey House, New York. $3.50.

Here is an interesting, complete excellent treatise on that absorbing study called microscopy. While the preface of the book addresses itself to the "hobbyist or avocationist" this book could very well serve as a fine reference for the high school or junior college student interested in the biological sciences. The book has accurate, detailed directions for the handling of the microscope, the preparation of material for observation and sources of supply.

All fields are covered where microscopical observation is necessary and profitable from the examination of fossil fragments, plant and animal tissue, organisms, to the examination of crystal forms in steel. These chapter titles convey an idea of the scope of the work: 1—The Microscope. 2—Temporary Mounts for Immediate Study. 3—Simple Balsam Mounts. 4—Procedures in Microtechnique. 5—Processed Balsam Mounts. 6—Cell Mounts. 7—Stained Whole Mounts. 8—Smear Preparations. 9—Bacteria. 10—Microscope Skeletons. 11—Grinding Hard Objects. 12—Sectioning: Manual and Freezing Methods. 13—Sectioning: Celloidin Method. 14—Paraffin Method. 15—The Newer Techniques. 16—Special Preparations. 17—Preparation and Use of Reagents. Appendix A—Sources of Supplies. Appendix B—Literature of Microtechnique. C—Reference Tables.

A. G. ZANDER

THE TEACHING OF SECONDARY MATHEMATICS, by Charles H. Butler, *Department of Mathematics, Western Michigan College of Education*, and F. Lynwood Wren, Julia A. Sears, *Professor of Mathematics, George Peabody College for Teachers*. Cloth. Pages xii+514. 15×23 cm. 1941. McGraw-Hill Book Co., 330 West 42nd St. New York, N. Y. Price $3.00.

This is a book not only for teachers of high school mathematics, but for supervisors who direct other teachers, for schools of education that plan the professional training of teachers, for graduate students who prepare

theses on the place and function of mathematics, for curriculum committees who prepare reports on modern trends, for school boards who purchase equipment for the school room, and for teachers in junior colleges who look for suggestions on the teaching of calculus. If anything has been omitted, the extensive bibliographies should take care of the omission. Obviously this is a very desirable book for a college student in a Methods Course, particularly so because it includes the ideas presented in the recent Reports of the Joint Commission and the Progressive Education Association.

About half of the book is devoted to a discussion of classroom techniques in teaching special topics in algebra and geometry such as: the solution of equations, graphs, directed numbers, simultaneous equations, operations with fractions, solving verbal problems, special products, factoring, exponents, progressions, sets of quadratic equations, and complex numbers. The chapter dealing with geometry discusses the content of geometry in junior high schools, the nature of proof, induction and deduction, indirect proofs, and presents very well the topics of converses, inverses and contrapositives which have been the center of much attention recently.

JOSEPH A. NYBERG
Hyde Park High School, Chicago

PHYSICAL SCIENCE, by Charles H. Nettels, Paul F. Devine, Walter F. Nourse, and M. E. Herriott of *Los Angeles City Schools*. Cloth. Pages xxiv+464. 15×23.5 cm. 1942. D. C. Heath and Company, 285 Columbus Avenue, Boston, Mass. Price $2.24.

This book is intended for use by student in the third and fourth years of high school. The selection of subject matter for a course designed to replace, for many students, the specialized science courses is in itself a job requiring much study and experimentation. The authors recognize five major divisions: science of the universe, communication and transportation, materials and processes, physical science in the home, and history and applications of physical science.

The plan followed in each of the fifteen chapters consists of (1) a preview, (2) description of phenomena, reactions, devices, etc., (3) questions asked and often answered to keep the student alert and to prevent formation of hazy ideas, (4) many learning helps consisting of directions for experiments, lists of questions, lists of learning activities, reading lists. Very little quantitative thinking is required and very few equations are used, either algebraic or chemical. The discussions are excellent, the illustrations appropriate and educational, the diagrams clear and supplied with meaningful legends.

G. W. W.

HISTORICAL PUBLICATIONS OF THE NATIONAL PARK SERVICE

The National Park Service, United States Department of the Interior, has recently issued 3 interesting series of historical publications, which may be purchased for small sums from the Superintendent of Documents, Washington, D. C.

The standard sixteen-page historical booklet, elaborately illustrated with historical photographs, prints and maps, is now available as follows: Abraham Lincoln National Historical Park, Kentucky, (10¢); Antietam National Battlefield Site, Maryland, (10¢); Chickamauga and Chattanooga National Military Park, Georgia and Tennessee, (10¢); Colonial National Historical Park, Virginia, (5¢); Fort Marion and Fort Matanzas

National Monuments, Florida, (10¢); Fort Pulaski National Monument, Georgia, (10¢); George Washington's Birthplace National Monument, Virginia, (10¢); Gettysburg National Military Park, Pennsylvania, (5¢); Great Smoky Mountains National Park, North Carolina and Tennessee, (10¢); Guilford Courthouse National Military Park, North Carolina, (5¢); Hopewell Village National Historic Site, Pennsylvania, (10¢); Morristown National Historical Park, New Jersey, (5¢); Ocmulgee National Monument, Georgia, (5¢); Salem Maritime National Historic Site, Massachusetts, (5¢); Shiloh National Military Park, Tennessee, (5¢); Statue of Liberty National Monument, New York, (10¢); and Vicksburg National Park, Mississippi, (10¢).

Numbers in the Popular Study Series, which consists of brief articles of general historical interest, are now available at 10 cents each as follows: No. 1, Winter Encampments of the Revolution; No. 2, Weapons and Equipment of Early American Soldiers; No. 3, Wall Paper News of the Sixties; No. 4, Prehistoric Cultures in the Southeast (in press); No. 5, Mountain Speech in the Great Smokies; No. 6, New Echota, Birthplace of the American Indian Press; No. 7, Hot Shot Furnaces; No. 8, Perry at Put In Bay; Echoes of the War of 1812; No. 9, Wharf Building of a Century and More Ago; No. 10. Gardens of the Colonists; No. 11, Robert E. Lee and Fort Pulaski (in press); No. 12, Rifles and Riflemen at the Battle of Kings Mountain; No. 13, Rifle Making in the Great Smoky Mountains (in press); and No. 14, American Charcoal Making.

Number 1 in the new Source Book Series, which is to consist of original and contemporary historical and archeological source materials introduced by explanatory comments, and compiled in relation to areas under National Park Service jurisdiction, is now available at 15¢, and is entitled: Yorktown—Climax of the Revolution.

AMERICAN INSTITUTE OF PHYSICS

First Report of War Policy Committee

Representatives of United States Government agencies, institutions of learning, the press, and various national associations are turning more and more frequently to the American Institute of Physics for information, advice, and cooperation from physicists as a national group. These appeals present opportunities for national service. It falls within the designated scope of the Institute to grasp such opportunities, but in order to do so it must first clearly understand the place of the science and the profession in the affairs of the nation and the world. Then it must accept the responsibility of speaking with authority about physics, of reflecting truly the wise consensus of physicists.

The war has brought new problems and rapid changes. It has placed physics in an important position; in fact, its present and potential contributions may well have a profound effect on the course if not the outcome of the war. The Institute has thereby acquired the responsibility of keeping abreast of changes, and of presenting to those concerned with the applications of physics and the use of physicists in the war effort, a currently valid and accurate portrayal of the science and the profession.

To meet these necessities the Institute established a War PolicyCommittee for Physics, with power to direct the "external" activities in which the Institute engages on behalf of the profession. The members of the Committee are: Dr. Oliver E. Buckley, President of the Bell Telephone Laboratories; Dr. Karl T. Compton, President of Massachusetts Institute of Technology; Dr. Homer L. Dodge, Dean of the Graduate College,

University of Oklahoma; Dr. R. C. Gibbs, Chairman of the Department of Physics, Cornell University, and Dr. Paul E. Klopsteg, President of the Central Scientific Company, Chairman. Dr. Henry A. Barton, Director of the Institute, is Secretary of the Committee.

There follows a report of certain conclusions and recommendations of the Committee:

1. *Professional status of physicists:*

Recent developments in technical and industrial trends have brought physicists into a position of importance in industry not heretofore existing." The present situation requires a more clear cut definition of "physicist. The War Policy Committee has adopted the following definitions as a basis and guide for its work and they are recommended to the Founder Societies for adoption:

(a) A *physicist* is one whose training and experience lie in the study and applications of the interactions between matter and energy in the fields of mechanics, acoustics, optics, heat, electricity, magnetism, radiation, atomic structure, and nuclear phenomena.

(b) To qualify as a *professional physicist* one must have had at least eight years of training and experience in physics. Toward this experience four years of formal collegiate education with major emphasis on physics may be credited, year for year, if it leads to a bachelor's degree, five years if it leads to a master's degree, and seven years if it leads to a doctor's degree, from a recognized institution. Years of teaching of physics in a recognized institution may be credited as years of experience in physics. By a *recognized institution* is meant one which appears in the list of institutions approved by the Association of American Universities.

2. *Training in Physics for the War:*

New tools of war have been devised which can swing the tide of victory. They utilize results of research in electronics, electric waves, acoustics, mechanics, and optics. Physicists have devised these new tools, engineers have shaped them for manufacture, and manufacturers are producing them. Men are needed to make the best use of them, to test and maintain them, to improve them, and to devise new ones. These men are of many kinds, from high school graduates to doctors of philosophy, but one thing they must have in common,—knowledge of the fundamental laws of physics on which the operation of these tools depends.

Training in physics for all of these operations and at all of these levels is urgently needed.

3. *Emphasis upon the Study of Physics:*

Even before the war the place of physicists in industry was becoming increasingly recognized. This is made evident by available statistics concerning the growing number of physicists employed in industrial laboratories, and the expanding membership lists of national societies in the field of physics. In the last two years, as a result of war requirements, the need for physicists, as compared with other professions, has grown very rapidly. Recent estimates indicate that the need is now growing at the rate of 1500 to 2000 per year, and that the current annual supply from schools is no more than 500. The need referred to applies to individuals having five or more years experience in physics in the sense of Section 1 (b) above (i.e., at least one year of study or experience after the bachelor's degree). It does not include the much larger need for individuals well enough prepared in mathematics and physics for training in technical war operations. This need has been officially estimated at more than 100,000. The War Policy Committee considers this a very conservative estimate.

Accordingly, it is urged upon officers and faculty members of high schools, colleges and universities to recommend immediately that students enroll in courses in fundamental physics and their prerequisites in mathematics, whatever the stage in the student's educational career. The recommendation should be made only to students who possess natural aptitude for these studies. . . . . .

Moreover, great new developments now appearing behind the veil of war secrecy are, beyond all possibility of doubt, establishing the basis for unprecedented peace-time applications of physics in industry. Some of the greatest of these are along lines not yet developed as branches of engineering. They give promise of opening large and fruitful fields for the useful and profitable employment of those well equipped with a broad, fundamental training in physics.

The Committee recommends to high schools that they emphasize mathematics through trigonometry, and that in teaching physics the aim should be to give a well-planned, thorough course in the fundamentals of the subject. Unless the high school is properly equipped to offer specialized training in the applications of physics, it should leave this to the higher institutions.

To colleges and universities the Committee recommends making provision for the most advanced courses for which students are qualified and, where facilities are suitable, the establishment of intensive courses, with laboratory practice, in electronic devices and high frequency circuits.

4. *Special training of physicists:*

Since the demand for physicists exceeds the supply which can be expected from the normal operations of schools and colleges, this Committee endorses the program of special agencies operating to supplement this supply.

5. *Use of Physicists:*

The need for physicists in the total war effort is so vital, and the demand so greatly exceeds the supply, that it is essential that every available individual trained in physics be placed in a position in which full use is made of that training. The Committee therefore would strongly endorse the adoption of any policies and regulations by the Selective Service System, personnel divisions of the Armed Services, and other government agencies concerned, to achieve this end more effectively.

SIGHT-SAVING CLASSES

Four colleges and universities, in cooperation with the National Society for the Prevention of Blindness, are offering courses for the training of teachers and supervisors of sight-saving classes this summer (1942). The institutions and the dates of these courses are as follows:

Peabody College for Teachers, Nashville, Tennessee, June 22-August 1.

Wayne University, Detroit, Michigan, June 29-August 7.

State Teachers College, Buffalo, New York, June 29-August 7.

Teachers College, Columbia University, New York, N. Y., July 6-August 14.

These summer courses will be of interest to teachers preparing to take charge of special classes for the education of children with seriously defective vision, and the courses will be helpful for nurses and social workers whose responsibility it is to aid in conserving the sight of the children under their care.

Details regarding the courses may be obtained from the respective colleges or from the National Society for the Prevention of Blindness, 1790 Broadway, New York City.